

August 17, 1959

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Futura Strength 180-3000
Minimum A380 2000

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HOW TO KEEP AN EYE ON RUNWAYS EVEN WHEN THERE'S "NO VISIBILITY"

In recent years, the job of the airport traffic controller has become increasingly difficult. Runways are longer. Flights are more frequent. And planes are landing with one mile visibility—or less!

Now—an illustrated "Eye" has been perfected that gives the controller a vision report of ground traffic even when there is "no visibility." Developed by the Autonics Instruments Laboratory—a division of Cudell-Hannen, Inc.—this Airport Surface Detection Equipment (ASDE) provides a high resolution radar picture of all airport, ground vehicles, and planes up to a 4 mile range of the control tower. This equipment is as precise as the best binoculars—standing at arm's length from each other 1500 feet from the tower—will

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AVIATION CALENDAR

24-25-Ca. Denver. *Space power American Rocket Society, Northwestern University, Evanston, Ill.*

24-26-Ca. San Diego. *The Astronautical Society, National Symposium Meeting, a symposium on air and space, under the chairmanship of Dr. W. E. Hart, San Diego, Calif.*

24-27-Ca. West Springfield, Mass. *Robotics, Space Technology, and Electronics, Massachusetts Institute of Technology, Cambridge, Mass.*

24-26-Ca. Springfield, Mass. *Space, Technical, Laboratories and Services, 20th International Commercial Spaceflight Symposium, Clark House Hotel, Worcester, London, England.*

24-26-Ca. Washington, D. C. *Space Utilization Program (SAMP) Symposium and Industry Briefing, Statler Hilton Hotel, Dallas, Tex.*

25 Sept. 3-Conference on Space Optics. *Washington, Association of Space Optics Society, Cortland, Minn., optics, Massachusetts Institute of Technology, 5-10th Annual Congress, International Astronomical Federation, Church House, Westminster, London.*

17-22-Conference on physical and chemical properties of the atmosphere. *University of Pennsylvania, Philadelphia, Pa. Sponsored by Air Force Office of Scientific Research and General Electric Co's Materials and Space Vehicle Dept.*

2-4-1970 *Computer Engineering Conference, University of California, Berkeley, Calif.*

3-4-National Convention and Aero Show. *Fairfax, Va. Area, Exhibit Hall, Dulles, Manassas, Va.*

3-5-National Conference on Drugs and Violence. *Society of Federal Assessors Contractors, Indianapolis, Ind.*

9-12-Sept. *Midwesters Conference on Film and Solid Mechanics, University of Illinois, Urbana, Ill., Austin, Tex.*

14-18-Sept. *International Conference on ASTRONAUTICS, University of Minnesota, St. Paul, Minn.*

14-18-Sept. *International Conference on Space Power, American Rocket Society, Northwestern University, Evanston, Ill.*

14-18-Sept. *International Conference on Space Power, American Rocket Society, Northwestern University, Evanston, Ill.*

(continued on page 11)



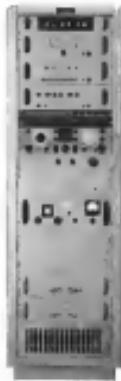
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Let's not kid ourselves — nothing is perfect. But we think you'll agree that the x-band radar antenna shown is about as close as you'll ever get. For example, reliability has been engineering into the western of this low-profile package by keeping the number of moving parts to a minimum one.

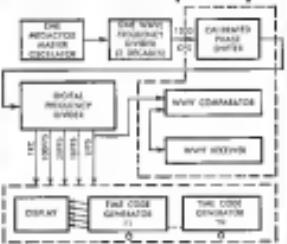
That isn't the whole story, of course. We could talk about things like modular packages for an-EL drive, how the feed exhibits circular symmetry to $\pi/6$, how we get high-speed rotation by rotation and an and on . . . But we figure your requirements are probably different than the next fellow's anyway, so why don't you write us if you want all the gory details? 15530 Quandt St., Van Nuys.





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Bridge, 1962

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The Heron System is at present being used for range time generation at some of the country's major missile test ranges.

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FEATURES

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AVIATION CALENDAR



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Soon the latest in ground radar from Crosby will stand watch along the coastlines of the approaches to the North American continent. Since 1955 Crosby's radar engineers have been at work—designing, perfecting, developing the important new radar unit.

See the FD-26 ground radio in study
at predators, and Avco's Ordnance Division
has been named prime contractor by
the U. S. Air Force.

The huge radar—so new that it is still classified—will be housed in a radome more than 30 feet in diameter. It will be mounted atop a readied concrete tower more than 70 feet high and will consist of more than 300,000 parts, including some 2000 tubes and diodes.

undertaking, where 1000 radars have been supplied. Handling the design and production of complex, challenging radars is "old hat" to Crookley, prime contractor of the successor MPP-18 height finder radar system, widely used by the armed forces.

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For more information, write to: Vice President, Marketing-Defense Products, Crosby Division, Dresser Industries, Inc., 1000 Arlington Street, P.O. Box 25, Olmsted Falls, Ohio.

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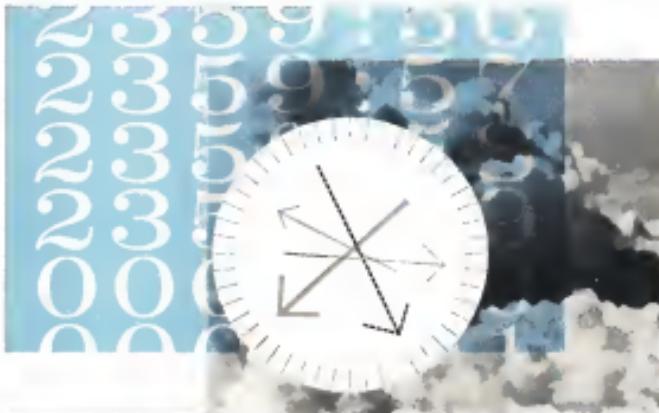
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Temco's Digital Timing System is a compact, accurate, airborne device capable of generating real time information for visual display at up to 21 remote indicators, for magnetic tape and graphic recordings, and as a source of coded digital time for master time transmission.

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BRIEFINGS

One in a series of technical reports by Bower

ROLLER GUIDANCE— VITAL FACTOR IN BEARING LIFE

Roller guidance has been established by the Anti-Friction Bearing Manufacturers Association as a major refining factor for roller bearings. There is a direct relationship between this factor and the life and capacity of a cylindrical roller bearing under load.

Figure 1 illustrates the results of a loose fit between a roller and the guiding ribs of the raceway. Because of lack of guidance by the ribs, the roller is free to slew and roll under load. Such a condition invariably leads to early bearing failure.

To achieve plane roller fit and proper roller guidance, Bower precision grinds each bearing race on specially designed centerless grinders. In this operation, Bower positions the integral stepped ribs on the theoretical centerline of the bearing. This method produces bearings with high dimensional accuracy and perfect symmetry.

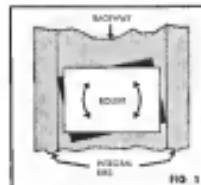


FIG. 1

In addition, the close tolerances held in grinding the roller track and integral guiding ribs give Bower cylindrical roller bearings the ability to take shear in any direction. A Bower cylindrical roller bearing has three capacity ratings

REGARDLESS OF HOW THE OUTER RACE AND ROLLER ASSEMBLY ARE INSTALLED. IT COMPLETELY ELIMINATES THE POSSIBILITY OF IMPROPER INSTALLATION.

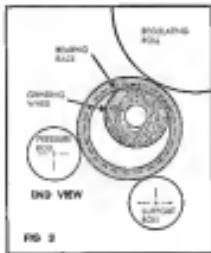
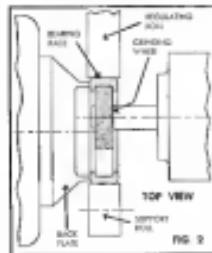


FIG. 2
FIG. 3

Whatever your bearing needs, we suggest you consider the advantages of Bower bearings. Where practical design calls for tapered or cylindrical roller bearings or journal roller assemblies, Bower can provide them in full range of types and sizes. Bower engineers are always available, should you desire assistance or advice on bearing applications.

FIGURE 4: In many cases poor roller guidance failure can occur even with solid under load.

BOWER ROLLER BEARINGS

BOWER ADJUST BEARING DIVISION - 20000 MILE, BOWER BEARINGS INC., DETROIT 14, MICHIGAN

Fig. 4. Poor fit in raceway causes poor roller guidance. Failure can occur even with solid under load.

LEAKS **CAN** BE STOPPED!



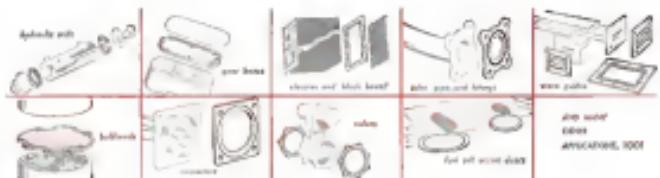
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EDITORIAL

COVIE—Pan American World Airways Boeing 707-123 Clipper Tradewind took out Aeroflot's Tu-154B-120 passengers Tapitalis Tu-154 while the latter was approaching at 12,500 ft above the Krasnoyarsk International airport during a flight en route to New York International Airport (DIA) July 6, p. 103. Pan American and the Soviet airline, Aeroflot, would meet en route from New York to Moscow under a reciprocal agreement still pending. For further details of the Tu-154, see, 30,35.

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Results of their work include spin casting processes for end-in-mold and moldless processes, and improved casting techniques. Casting methods have been developed for many of the newer magnesium alloys, such as the elevated



THIS MAGNesium HUB CAP was cast in 1961 in an experimental diecast. Before construction of automotive castings, the foundry has extensive experience in diecasting, both aluminum and magnesium.



THIS MAGNesium HUB CAP is exhibited in close-up. Left casting is diecast; right casting is sand cast.

More About the Dow Magnesium Foundry. For complete information, write or call: President, Dow Chemical Company, Midland, Michigan.

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EDITORIAL

Defense Trends

The passage by Congress of the fiscal 1960 Defense Department appropriations bill provides some interesting clues to the trend of the defense budget over the next three to five years if present policies continue.

Signs of the fiscal 1960 appropriation bill into law by President Eisenhower will launch off a series of announcements from the Pentagon canceling and cutting back major weapon development and procurement programs. At a usual in such cases, the official excuse will be that these slashed programs are "surgeal" and that it is "easier and unexpensive" to continue than to review of the new super weapons that are just around the research and development corner.

In fact, the military usefulness of these weapons will have little to do with these actions. They are dictated solely by budget considerations that are getting tighter and tighter each year while both the Congress and executive branch of the government fail to face up to the genuine problem of providing a technologically modern and militarily superior defense program.

A further indication that the situation with a constant level defense budget in the face of rapidly expanding guidance is the key to all defense programs is found in Defense Secretary McNamara's blunt admission that the fiscal 1961 budget will require a 10% across-the-board cut in all weapons development and production programs. That 10% across-the-board cut for fiscal 1961 piled up 10% of the major cuts already required by the fiscal 1960 budget cannot help but result in a greatly reduced defense capability in the critical decade of the 1960s.

The defense in which the Pentagon now finds itself with a constantly decreasing defense capability (this is what the slogan of a constant level defense budget really means) in the face of a constantly increasing challenge from the Soviet Union is a result of the failure of military and civilian defense leaders, the Congress and the President to really tackle and solve the complex technical, fiscal, and organizational problems involved in long-term effective modern defense capability.

Basic fault lies with the military hierarchy that has constantly placed its individual service welfare above the overall considerations of an effective national defense.

The inability of military leaders to make decisions and settle vital matters of military policy within the frontiers of the Joint Chiefs of Staff has resulted in the impasse of a stagnation of civilian "experts."

These "experts" were given the job of making the decisions upon the military dogged and of revamping the obsolete land, sea and air structure of the defense organization. The superstructure of civilian bureaucracy erected on top of the military politicians has also failed significantly in making any effective program. It has largely added another tangle of red tape to Pentagon processes. And by its failure to make decisions, it has opened the door for the backslapping of the Budget Bureau to make vital military decisions based solely on fiscal considerations. The Jupiter Thor parallel production program, the Nike missile job as well as Mr. McNamara bravely admitted the Pentagon could make no decision and invited Congress

to "hold our feet to the fire," provides specific examples of how in lack of military decisions wastes money and out providing any real increase in defense capability.

In view of the situation, which has grown steadily worse during the past five years, it is most revealing that Congress has been drawn into the vacuum created by the Pentagon's inaction and is now attempting to plug the sole original cut for the Joint Chiefs of Staff and the Secretary of Defense. We can hardly blame Congress for attempting to bring some order out of the defense chaos. But its efforts during the current session indicate clearly the ludicrous and contradictory decision that emerge from this activity.

The Nike-Bomarc controversy provided the ultimate absurdity when a House group recommended cancellation of the Bomarc and expansion of the Nike program, while a Senate group studying the same problem favored the Nike system "ridiculously obsolete" and recommended expansion of the Bomarc program. Clearly no much progress will result from this type of activity.

The result of this drafting, indecisive trend where only the Budget Bureau backslaps will make decisions has sharpened inter-service rivalry to an intensity almost beyond reason, but left the top level confusion in the Defense Department unheralded as a welter of confusion and misdirection, and has turned most of the excellent of Congress into military "experts" second guessing the Joint Chiefs of Staff. All of this means that we are getting precious little in genuine defense capability from the close to \$40 billion we are pouring annually into the Pentagon budget.

The probably small losses we were able to make to meet the twin crises in Lebanon and Formosa last year provide a measure of this situation. While defenders of the military budget have cited these efforts as proof of our effective defense capability, it is interesting to note that they have not discouraged the Communists from attempting similar efforts, including the brush fire now burning in Laos.

Most money is certainly not the sole answer to our future defense problem. We need to make more effective use of the billions already provided before vital changes can be made for more.

What we need even more is development of a technically and politically modern defense strategy and a defense organization that effectively integrates all elements of the three services into this strategy rather than attempting to equip each service to do the entire job by itself.

We also need a program to honestly inform the American public on the requirements of such a defense program in place of the manipulated half truths now emanating from the top level of the Pentagon in a futile effort to maintain over the expanding costs in our defense structure.

We also need a determination that extends from the great needs of our 50 states up into the White House and Congress that we can and will do whatever is necessary to protect the country in a beacon of hope shining out over the dark seas of Communism's expansion.

—Robert Hite

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WHO'S WHERE

In the Front Office

At Convair F. B. Fonda, a director of The Mathematics Group, Ltd. brought together, England and two of the companies with in the group, Mathematics Group Ltd. and English Electric Co. Ltd.

William G. Brueckner, a director, Assurance Worldwide, N.Y. Mr. Brueckner has been in his present and past manager.

Frederick E. Lusk, a director, DikLus Corp., St. Charles, Ill.

Robert M. Rosen, a director, Standard International Corp., Los Angeles, Calif. Mr. Rosen continues in his present position.

Stanislaus R. Clegg, a director, Control Data Corp., Minneapolis, Minn., and director of engineering of the Computer Division. Former corporate vice president, William R. Klemm, has died and is being mourned. James G. Klemm for chairman.

Hubert Freudenthal, president, The Dornier Metal Products Co., a newly formed division of The Dornier Chemical Co. Michael Meth, Mr. Dornier's son, Donald Housner, vice president, Werner H. Lenz, vice president and chief financial officer, and H. G. Lenz, vice president and sales manager.

The R. Stephens, president, Canadian Pratt & Whitely Aircraft Co. Ltd. Maxine, Ont., Canada, succeeded Ronald T. Bates, deceased.

William L. Rodick, president, Continuous Filtration Div., Novellus, Calif., a subsidiary of Diamond-Plus Corp., Novellus, Calif., a subsidiary of the Filtration Co.

Robert F. Gray, president, U.S. Scanco Corp., a subsidiary of Vought Industries Inc., Los Angeles, Calif.

Robert J. McLaughlin, president and director, formerly president, Winx Co., Inc., Tarrytown, N.Y. Mr. McLaughlin died.

Robert L. Goffle, vice president, Delta Air Lines, Inc.

Andrew C. Burke, vice president, research and Technical Services, Lockheed Co., Woodland Hills, Calif.

Dr. Harry Strohmeier, vice president and manager, engineering department, Electro-Science Research Corp., Mountain View, Calif., a subsidiary of Electro-Mechanics Corp.

E. G. Veltin, a vice president, Texas Instruments, Inc., and director manager of the Micro & Control Division, Dallas, Texas.

Engen S. Goelet, was president, market for Europe, Cambridge Mass.

Philip R. B. Smith, was president, The New York Air Brake Co. Mr. Smith continues as general manager of the Waterbury Division, Waterbury, N.Y.

Capt. John R. Haffhausen, vice president, operations, Enduro Air Lines, Inc., was elected chairman of the National Aviation Meeting. Also, Andrew J. Chalke, vice president, engineering and manufacturing, engineering, Capt. Fred L. Ritter, assistant vice president, flight operations.

Charles A. Carroll, vice president and manager aircraft sales, The Baldwin Co., Pleasanton, Calif.

Howard W. Hobart, Chief International Field Service Division, Office of International Cooperation, United Nations Agency, Washington D.C.

(Continued on p. 118)

INDUSTRY OBSERVER

► Project Trident, primary space program for which Navy has been given the go-ahead by Defense Department that far, consists placing a navigation satellite system into orbit by 1964-65. Booster for the project will be purchased by the Navy at all-the-class.

► Initial evaluation tests on Tactical Air Command's "portable avionics SAGE" air defense system will begin in the next letter of State, AFSC, N.C., using five radars sites located at air bases in North and South Carolina and in Georgia. The system, developed at AFSC, includes three types of search radars—a short-range low-altitude site, the AN/FPS-20 three-dimensional intermediate range site, and an all-weather, the third a two-dimensional AN/FPS-32 extremely long range site. Last two are produced by Westinghouse Electric. Tactical air controllers are supplied by Litton's Rand General Electric is responsible for system integration plus data processing and display subsystem.

► Avco recently sent out four companies competing for its Minuteman field air defense missile program to learn of any new ideas that had been developed since the original proposals were submitted in December. The often-posted deadline is now expected to be made within the next several weeks. Bidders include a Convair-Kearfrost team, General Electric, Martin and Sperry Gyroscope Co.

► Navy, if it can find the money, is considering retrofitting the Douglas A-4D attack bomber with the 7,500-lb-thrust Pratt & Whitney J75 engine. Navy officials say installation of the J75 as a replacement for the present 7,200-lb-thrust Wright J65 should provide substantial improvements in performance and reliability.

► Navy also may adopt the 5,000-5,000-lb thrust Pratt & Whitney JTF-104-1 after engine developed for Douglas DC-9 transport for use in the Convair A-1F "slew," plane designed to attain a speed of Mach 0.9 at sea level. Original program called for use of the J72 turboset in the two-engine A-1F. Under present planning, first production version of the JTF-104-1 are not scheduled before the summer of 1962.

► More than 100 of the nation's top civilian and military scientists completed a 10-day symposium last week on ballistic missile defense problems and possible solutions. Classified symposium was sponsored by Advanced Research Projects Agency.

► Last of the planned proposed Nike Hercules anti-aircraft missile installations for the continental U.S. is scheduled to be in operation by mid-1960 according to present timetable.

► Navy hopes to fire the first air-launched Polaris first ballistic missile from the USS *Compton* Island within the next four to six weeks.

► National Seawar Engineering Co., Pasadena, Calif., is conducting advanced analytical studies relating to the dynamic response of Navy's Polaris first ballistic missile system under subcontract to Lockheed's Missile and Space Division.

► North American Aviation and Boeing Airplane Co. are performing basic aerobatic analyses for Air Force under Study Requirement 34, with costs of approximately \$100,000 each.

► All Douglas Nike Ajax and Hercules anti-aircraft missile units scheduled for use in the Italian air force will have the primary mission of defending the *Corsepoli* western side of U.S. Army's Southern European Task Force in northern Italy (AW July 25, p. 31).

► Douglas Aircraft officials say the Nike Zeus system will have an anti-orbital capability as addition to its principal drug function of destroying ballistic missiles.

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Washington Roundup

Radical ARDC Shuffle

Radical reorganization plan to re-group all Air Research and Development Command activities under one director—Ralph M. Moore, Space, Aerospace Systems, Electronic, Guidance, and Control, and Research—was submitted to the Pentagon last week by Lt. Gen. Joseph A. Schlesinger, ARDC commander. In his proposal, Under the plan, ARDC would establish a central headquarters for all of its electronic activities in the Boston area to direct and coordinate efforts of Cambridge Research Center, Air Development Center, Research and Development Center, and most of the major equipment laboratories at Wright-Patterson Air Force Base. Headquarters for Aerospace Systems Division, responsible for research aircraft and related weapons, would be located at Wright-Patterson AFB, while Defense Systems Division headquarters probably would be located at Edwards AFB, although Holloman AFB is a contender. Research Division headquarters probably would be located in Washington. Weapon Systems and Electronic Support System Project Office, now in Dayton, would function as a part of the appropriate division and then provide a local point of contact.

It appears the plan, prepared by an ARDC group headed by Col. J. C. McHugh, is expected to result in transfer of some 1,000 personnel from WADC and BADE to the new Boston division headquarters.

No Rush for AMP Changes

Apparently there is no hurry at top Defense Department levels to find a new management approach for the Aircraft Nuclear Propulsion program. Defense Secretary Neil McElroy has said there are some considerations in new approaches about, but that no process has started him yet. As for a deadline on new management proposals, he said: "Well, I'd say that this isn't something that I am pressing for. I really don't have a time in mind."

AMP program director Maj. Gen. Donald Korn is retiring. AMP has been reorganized in a good deal of a haphazard way. A few days ago General Gen. George E. Branch replaced Korn as his USAF job, but Branch was not named to take Korn's job as director of the Defense Department and Atomic Energy Commission AMP efforts (AW Aug. 18, p. 21).

Banana Base Study

Department of Defense is making a detailed study of the possibilities of locating Banana sites in Congress House Appropriations Committee's total construction funds with the understanding, The money for sites in the northwestern part of the U.S. between the Great Lakes region and the Pacific Coast won't be used until the study is completed and prospects for the Canadian sites explored.

The committee commented that Defense Department's "master plan" of about 100 sites and Banana installations for its defense "is a waste site in the right direction," but it is "to no use in the last analysis, it leaves much to be desired."

Defense Secretary Neil McElroy was in Canada last week discussing North American air defense matters with Canadian Defense Minister George Pearle. Discussions included the role of Bananas in a theater of particular inter-

est since Canada has decided to buy an Boeing intercepter aircraft instead of the canceled Avro CF-105 Arrow aircraft jet interceptor.

Mac Site Funds Deleted

In another vote, the House last week took another action to dismisse Air Force funds having any connection with the Soviet Maccabee missile. It cut \$6.4 million for Mac site facilities in Europe from fiscal 1960 construction funds, which are now pending return to the Senate. Earlier, the House cut Mac procurement funds from the fiscal 1960 Department of Defense budget. Also a strong plus from Air Force, the Senate granted authority to transfer funds from other programs for Mac if Secretary of Defense first certifies to the House and Senate Appropriations Committee that it is "essential." The House agreed to the Senate proposal.

Khrushchev's Military Sight-Seeing

Soviet Premier Nikita Khrushchev will be free to inspect a scale model of major military installations in the U.S. next month, and he will be free to decide whether the Soviet state to visit military bases. Khrushchev has indicated he wants to avoid military installations to avoid giving his visit a military cast, but both President Eisenhower and Defense Secretary Neil McElroy think the Soviet premier ought to get a first hand picture of the strength and competence of the U.S. defense posture. Eisenhower said last week that Khrushchev will have a fairly wide choice in the character of installations open to him, and McElroy has suggested that Air Force Missile Test Center at Cape Canaveral and a Strategic Air Command base are the types of installations he might use.

McElroy's press conference statement that Khrushchev might be admitted to installations soon by the press but not open to the American public enraged Assistant Secretary of Defense for Public Affairs Major Stanley Strode to need to a correction. McElroy and that Major "feels terrible when we say that we have to have [Khrushchev] things which the American taxpayer is paying for other to use. I think that I should follow up with a statement that we could not under any law be doing so and the thought that our people in the press have seen our things which the average citizen is not allowed to see but that there also we are careful to abide by the law in the way we extend this privilege to you. I am not wholly sure who that is required, but I abide by my own advice."

Petty Resigns

George R. Petty, Jr., resigned unexpectedly last week in president of the Flight Engineers International Assn. with FEIA executive vice president Russell Brown taking over until the vacancy can be filled at a soon election scheduled for late spring. Petty resigned "for general reasons," according to an FEIA spokesman. His resigning, however, came after a planned meeting between FEIA and the AFL-CIO in which the two organizations' views with the Teamsters union. While FEIA has accepted into its membership, many to affiliate with the union headed by James Hoffa.

—Washington staff

Air Force, Navy Face Procurement Cuts

Tight Fisical 1961 budget ceilings force reviews of weapon programs; boron fuels are early casualties

Washington—Sharp cuts in Air Force and Navy procurement programs are now being pushed through as a result of an Administration decision to hold Fiscal 1961 defense spending at present levels plus the spending out of advanced weapons inventories.

Some cuts already have been ordered, others will be made within the next 60 days as the Fiscal 1961 budgets of the two services become available. The Army also probably will feel the cut to some degree, but the overall effect will be relatively light.

Delayed or curtailed are Fiscal 1961 spending on the approximately \$40 billion defense budget authorized in fiscal 1960. Both Air Force and Navy are now conducting reviews to inquire areas of excess spending in their inventory management programs already approved for Fiscal 1960 as an effort to make additional funds available for top-priority projects.

An Air Force spokesman said the best place to look for savings is in the development of the high range fuels and the General Electric J58 chemical rocket planned for the North American F-104. Mach 2 fighter and the fiscal 1960 procurement program for Convair's F-86 Mach 2 fighter from 40 to 32. Chairman of the Air Force has informed the plan for the B-57 fleet for wings for three weeks with over 500 aircraft in a total of 35 aircraft instead of the 45 originally programmed.

Other inventory savings planned in the Air Force include:

- Delays in fiscal 1960 procurement programs for the Boeing B-52B intercontinental bomber from the '70s deferred to '60.
- Diverting disengaged funds planned for a new early warning and control aircraft to other aircraft.
- Sharp curtailment of buying programs for the McDonnell Quail electronic countermeasures missile planned for the B-52.

Specific Navy cuts are now being thrashed out in the Office of the Chief of Naval Operations with the four divisions scheduled to be made in the first of the month.

The cutbacks in both Air Force and Navy budgets will go much deeper than financial savings from earlier and procurement programs. One Pentagon spokesman said last week that "we'll slash everything as much as we can. Now that's going to have to be a central idea... we're not going to have fewer programs." For another take on cutbacks see p. 291.

Defense Secretary Robert McNamara, in announcing the Administration decision to hold Fiscal 1961 spending to the fiscal 1960 level and the decision not

end \$16 million on the development of the F-104. The Navy has spent \$15 million on the construction of a primitive test plant at Muroc, Calif., and of orbital vehicles on board had developed some 100,000 pounds of propellant.

While the Air Force documents are raising speculations about the future of both the F-104 and B-57 programs, it will focus on the future of advanced military aircraft as a general. The F-104 and B-57 along with North American's Mach 3 F-108 fighter are still on the program at present. New plans call for the B-57 to use the J58's engine, which General Electric was developing to parallel with the J58. Designed primarily for the F-108, the J58 will use boron-based fuels throughout, possibly some of the newer and more powerful boron-based fuels now under evaluation. Wright Air Development Center (AW, Aug. 30, p. 27).

The boron compounds are not to be dismissed completely just yet as possible high energy fuels for future aircraft and missiles. Original estimates for the construction of production aircraft will be 1963, but the development effort is the best kept secret now.

In addition to the Air Force and Navy, National Aeronautics and Space Administration and Advanced Research Projects Agency are reported to be sponsoring research and development work on the boron fuels (including the efforts not under way to develop a solid boron base propellant fuel mentioned).

The production stage order, which is believed to have originated with the Department of Defense, rather than with an individual military service, sought most Air Force Navy and in flight growth involved in the program in support. At current indications are that the decision was based primarily on economic considerations rather than military requirements.

In total, the canceled fuel programs enjoy a potential total cost of as much as \$100 billion. To date the Air Force has spent \$55 million on the development of boron-derived fuels.

It was discovered early, however, that some combination as a jet engine the boron-based fuels formed a brittle oxide bridge in boride clusters, such as nitrides and titanides, that virtually precluded their use in the hotbore portion of the engine. The shoddy design was discarded as afterburner salts, which forth lowing its existence.

But scientists believed that could be fixed the afterburner problem of the boron. And last October President Eisenhower, in his speech to Congress, in the ranks of NASA, disclosed that a



First Photo Shows Navy Tartar Launch

First photo shows Tartar experimental missile-to-air guided missile being launched from USS Norton Sound, a guided missile ship, off the Pacific Coast. Missiles' incorporation is similar to that of the second stage of Navy's advanced version of the Convair Tartar (AW, July 26, p. 79). Tartar is about 15 ft. long and about 1 ft. in diameter. Shown, positioned on Navy Bureau of Ordnance by Convair (Paramount) Division of General Dynamics Corp., will be primary surface-to-air weapon on destroyers. Armored General dual-threat shielded radar guidance high threat during launch phase.

one afternoon had been designed and tested which was found to be "apparently free of the boron oxide deposit problem than earlier versions." Plans to put the liquid boron fuels into large-scale production moved ahead. As late as last May, the Air Materiel Command's Armament Systems Center at Wright-Patterson AFB was studying the matter of expanding the production facilities into radioisotopes, in light of the large demand generated for the boron-based fuels in 1965.

Seiddments of Concessions

The addressed of the cancellation order caught the Acoustics Division Center oil plant. Apparently, from who could be termed USAF head-quarters did not consult with either Air Materiel Command or Air Research and Development Command, prior to making its cancellation decision and an announcement.

As a result, annual shutdown plans and procedures are still in a state of flux.

At the end of last week, however, there was what had already transpired and

what was expected to take place in the near future.

■ Defense Department awarded a contract for a study of the curve boron fuel situation to Arthur D. Little, Inc., which was already pursuing this field for the Air Force (AW July 13, p. 23).

■ Electropurification USAF last week notified Congress that it had canceled its contract with General Electric for the development of the J58's engine. Following that came word that it had dropped its plan to procure the boron-based J58 high energy fuel.

■ Following shortly upon USAF's cancellation of the J58's and boron-based production, the Acoustics Division Center was forced to close its production plant at Model City, but to continue research and development effort on boron fuel manufacturing processes. Skidmore will follow this week.

■ Research and development effort on manufacturing processes goes primarily to a contract USAF Manufacturing Methods Division has with Skidmore. An effort for development of a low cost method of making boron-based fuels. This process will be proved out in a

XGAM-87A Engine

Anglo-German Corp. will be possible to postpone its Boeing XGAM-87A aircraft engine development program. One Pentagon spokesman said last week that "we'll slash everything as much as we can. Now that's going to have to be a central idea... we're not going to have fewer programs." For another take on cutbacks see p. 291.

Defense Secretary Robert McNamara, in announcing the Administration decision to hold Fiscal 1961 spending to the fiscal 1960 level and the decision not

large joint plant now under construction in Sacramento, Calif. A Strategic Council of Co. officials told Aviation Week that last week the Air Force decision was so far off track.

At Model City, Okla., Mathiesen outlined to both the Navy's joint plant and Air Force production facilities, and is currently awaiting instructions from the Air Force on both counts as to how much longer Air Force production should be delayed to give the first batch of B-1B's until the end of this month. The contract has closed on its own plant.

In Pittsburgh, Calfee Cheated Co. is also awaiting clarification of plans concerning the closing of the \$35-million Navy plant at Allentown. The fourth and final unit of that plant was scheduled to go into production this week. Calfee's 100-500 million-hour fuel facility in Louisville, Ky., will remain in operation. This plant was designed to produce small quantities of the high-energy basic components for any required development as well as to serve as a small refueling source. Calfee expects that its basic fuel research and development contracts from the Air Force, NASA, AFPAK and NASA will still remain open. Consequently, most

of Calfee's basic research development and plant facilities, located in Pittsburgh, will probably stay in operation. At Elyria, Ohio, last week, Gen. Electric was operating official word exclusively on the continuation of the 1955 contract. Neither General Electric nor North American officials felt that this would affect the development of the B-70 and F-104. At the same time, the Elyria General Electric research and engineers were continually disappointed by the consistency of the basic burning curves of the 193 which they considered as important part of meeting the weapon system needs for the B-70. General Electric researchers are thus have the "super in-depth" funds (AW Aug. 16, p. 27), that led to that much hardware a basic fuel for a refuel. The B-70 in which the use of basic fuel was expected to achieve performance (principally range) roughly 10% over that of the reference fuel.

Some defense officials, officials contend that these cancellations will among other things, further increase the basic fuel of thermal companies about getting into the aircraft and missile production business.

On Aug. 14, after closing at 1,000 and at 500 Boeing last week was down to 550. Since market and atomic companies on the other hand had given up with the exception in the time period and seemed on the verge of shutting down, respectively. Prices for 90-100 tons savings were not uncommon for models like Thielert Chemical Corp., Aviagut Corp. and Lettow Industries.

A market decline, the result is in the market decline, although again this may go to affect the fortunes of the less well-financed companies like Boeing and Douglas. This could then also be enough defense spending to produce the tremendous growth demanded in the market for more of the rocket and missile stuff.

Perhaps the Elyria-Allentown vs. Calfee will emphasize that question will the market's doubts about the market were about the existing fuel and price. Price will affect the big fuel. Models, but history passed this off as the expected outcome and noted to see what it will be in the long sight.

Discussions about the future in the Pittsburgh area will be pre-empted by the other three months ago.

Boeing Douglas and General Dynamics are all engaged early and prior to the release of studies about costs in defining spending into studies and the cost not because the big commercial jet program of both were resulting in heavy development costs.

With such costs at Martin Co. showing sharp rises sheet the was that this might have been thwarted as switching from company's model to the public with emphasis to companies engaged as though as based on studies.

The B-70 and B-1B General Wright's 175,000-tonne gross weight of aircraft in the market price at \$75 a share. Based on a budget 1970 figures, this 90,000 times the company's current price of \$1.34 a share.

The stock, though not glorified yet may not succeed but the market will begin again to look forward. After that instance we begin the longer term of the traditional standard of dividend return and earnings and have been to sell off a big profit to increase the market value of the basic company is not the most of the potential reaction begins.

The long-term trend of aviation stocks are long evidence reached the time, however, demonstrating.

• Since about 1960 there have been major demand in cycles every 1966. This year the price range for Douglas Aircraft was \$5.22. The next year the range was \$1.90 and last year it was \$1.44. Last week Douglas was selling at \$1.45 a share. Douglas Aviation Co. in 1970 after a stock split sold in a \$3.45 range. The next year the range fell to \$1.79. Last year the range was

Klomthaler will exchange units this fall but little information passed on the securities market, we believe that the new market is both look at the aircraft industry as well as the aircraft industry. Needless to say, any such reduction of international tensions, stability of oil prices, taxes are an incentive for model like Thielert Chemical Corp., Aviagut Corp. and Lettow Industries.

A market decline, the result is in the market decline, although again this may go to affect the fortunes of the less well-financed companies like Boeing and Douglas. This could then also be enough defense spending to produce the tremendous growth demanded in the market for more of the rocket and missile stuff.

It viewed the prospects of Boeing, Douglas and General Dynamics in less favorable because of the heavy fixed operating expenses of continued jet transports. Regardless of the past and cost of this line of thinking which is common in the market, nevertheless, these were developments to support it and to add to the market price.

• United Aircraft Corp. its quarterly dividend from 75 cents to 90 cents a share and reported first half fuel and earnings of \$74.52, \$2.56 and \$15.38, \$16, respectively, had declined from \$15.38, \$16 and \$12.37, \$6.91 last year.

• Boeing Aerospace Co. reported a sharp drop in the first half fuel and earnings of \$77.36 and \$2.75 a share, down to \$51.51, \$6.68 or 40 cents a share. The 1968 sales of \$6.7 billion for the second half year in 1967.

• General Dynamics reported earnings for the first half fuel almost 50%—from \$52.05, \$2.02 last year to \$16.63, \$1.89. Sales showed a relatively small decline from \$70.8 million last year to \$75.2 million this year.

United's dividend did not go up and improved to the market, although it lowered the share price down from \$51 to \$48 on the news. United's cumulative records and development expenses for the first half of 1970 totalled \$12.700,000, which increase to \$18 million, a record, and 10% or were beyond the figure in 1969. Expectations for next year are for a 10% increase, which is projected to total \$19 million in the next 15 months and have a percentage which amounted to \$1.2 million in the first 30 are projected to increase to a much higher level by year-end. Although 1969 sales will receive high the percentage and it seemed advisable to use the dividend in the light of these burdens on earnings.

News of the basic fuel cancellation gave Wall Street a special case of the situation. Though the North American B-70 program itself seemed secure, way in investment houses — Benth, Bausier and Co., Bode, Koller, Peabody, Peacock and Co., and, respectively, Ladd and Co. had issued reports concerning North American for purchase.

Where the dry-lease market can lead to about the basic long-term trend the spectrum of the rented funds and maintenance may provide a better overall indication of what is happening.

An example is Keystone Capital Funds Inc., which manages a \$479 million stock portfolio broken into several types of individual funds. The situation was that if there is no deal, in the end, the way should do and those in these same companies would be in a strong position to compete for the smaller number of defense contracts.

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first four months of this year, a clear trend away from Boeing, United Aircraft and Douglas became apparent. For example, after tracking the results of various purchases and seven bids since Boeing, the oil market has risen 155,500 shares. United Aircraft showed a return of 215,100 shares after seven purchases and seven sales.

Massachusetts Investors Trust, one of the largest funds played a major role in this. It sold 110,300 shares of Boeing in the first quarter, leaving a holding of 90,000 shares, and in the first half sold 72,100 shares of United, leaving a holding of 75,000 shares.

Martin and North American were the big losers in the aviation field. Martin showed a net loss of 117,100 shares in fund funds and North American 61,200.

Only fragmentary reports are available on the other defense contractors, but these indicate that it is not unusual in this financial industry. Keystone said, "It's technological progress and cost inflation, as well as which trends seem likely to be seen reversed. The first factor includes increasing proprietary research and development, short production runs and increasing expenses to eliminate, all conditions equating with success and profitable profit margins."

A check by Aviation Week on the past two years showed an clear trend through the end of last year. In the

Pace Aims at Greater Civil Volume

New York—Program officials are involved with the current emphasis on research and development. Paul Fier, Gen. Dynamics' director of business development, told the New York Society of Security Analysts last week that, but he added, "I think this is a good sign from the point of view of not oversupply and for the country. From the company's view, we are willing to take our chances for as we are advised we will get more share of new business. From the company's point of view, that is the way we get the best defense situation."

However, Fier pointed out that General Dynamics was increasing its commercial volume joined a 50-50 goal. "If the net earnings of our proposed acquisition, Materials Service Corp., were included in our 1978 figures, we would be 15% commercial," he said. "While our commercial program has been slow, we should work on either the 50-50 or 70-30." Fier said that the program had just over equated the company had for them—with one exception. The worldwide market did not develop as the company expected, and it had eval-

uated the medium range jet market as potentially the largest. One reason for this is not, but the heavy financial demands on the services which ordered the program.

But they are not set a responsible medium range market in the works. Fier and the 50-50 or 60-40 in the fastest advancing area could have a massive market 140 of 10 years and perhaps 15 to 20.

Computer President Earl D. Johnson, right to a question about write-offs on the project, said they were at a point now. "Barring any major certification problems—that seems unlikely—they should begin to taper off. One reason for this, he said, was the fuel market the company learned about the high speed airplane in the B-58 Hustler expenses burdened program which served costs."

Another point is sound approach and return to the market, and they were at a point now.

"Barring any major certification problems—that seems unlikely—they should begin to taper off. One reason for this, he said, was the fuel market the company learned about the high speed airplane in the B-58 Hustler expenses burdened program which served costs."

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EXPLORER VI PAYLOAD is prepared for installation on third stage of Thor Able III launching vehicle. The 20 x square centimeters folded down below the payload have 1,000 solar cells on each side and are providing electrical power for operation of the satellite's instruments. Hole on top of the satellite is the nozzle of the small rocket used to raise perigee of a low orbit too close to earth, as was not used.

belts. These were missioned by various earlier Explorers, satellites, and by Pioneer I and Pioneer III. But Explorer VI will provide more complete data on a greater variety of particles. Data on a range of particles in the earth's field will be in the plane of the satellite's orbit and provide data on the radio belts where they are strongest.

Radiation counters in the satellite are measuring three energy levels. A device developed by the University of Chicago measures high energy particles. It consists of an open cylinder enclosing a search coil and a lead-shielded particle detector. Particles will enter the coil and cause an electrical impulse in this detector as they pass through.

Middle energy range is measured by a combination of two detectors provided by the University of Minnesota. One is a silicon diode and the other is a Geiger-Muller tube. The two detectors are connected in parallel circuit. In another, signals from one of the two detectors are received

by a Geiger-Muller tube to count rate.

Low energy range is measured by a combination of two detectors provided by the University of Minnesota. One is a silicon diode and the other is a Geiger-Muller tube to count rate. STE, scintillation counter is used to measure low energy radiation.

Detractive and pattern of magnetic fields in the earth's field by Explorer VI is measured by metal plates on opposite sides of the satellite's waist. Microphones pick up impacts on the plates for ionization measurement.

Magnetic field of the earth in most used by magnetometers developed by STE. Standard magnetometer gives the magnetic field and its direction and a fluxgate magnetometer is used with it to measure the ignis and component of the field. STE also has developed a phase compensated which measures the phase compensation between the output of a vanadium and the search coil

by two vanadium sensors spaced on a 475 meter base line to measure amplitude and phase fluctuations induced by the atmosphere. Ground equipment for this experiment is in place at the National Bureau of Standards Laboratory in Boulder, Colo.

Signals from UHF and VHF transmitters will be used at the Kaho, Hawaii station in a conjugation of doppler shift. Ground equipment of the two transmitters will provide data on the relative effect of electron density in the ionosphere on signals with these two frequencies. STE's signal also will be used in the Hawaii station to determine the Finsler rotation due to variation in electron density between the satellite and the ground station.

Internal temperature of the satellite is controlled by surface treatment of the skin. Readings are taken from an internal temperature and temperature of the solar cells. An experimental device for controlling temperature inside the satellite being tested resembles a domed-bladed propeller on the shell. A heat-absorbing black patch is on the surface with a white and white shell. When the patch rises to a certain level, the coil expands and rotates the propeller which moves to cover the black patch. When the covered patch rises, the coil rotates the propeller away, exposing the patch and allowing temperature to increase.

Explorer VII is tracked by a number of U.S. ports, but principal command and data reception points are at Jodrell Bank, Manchester, England, Kite, Norway, Midtjorne Hill, S. H., Singapore, Malaya, and Cape Canaveral. These points are connected by a tele-type circuit with the control point at STE's Space Navigation Center in Los Angeles. Experimental data will be partially reduced at tracking sites before it is moved to STE for complete processing.

Multiplexers have been installed on antenna at Jodrell Bank and Hawaii to permit reception and transmission of signals on a single antenna at the same time.



THOR ABLE third stage (longitudinally) is solid-pumped; second stage undergoes testing.

New Navy Radar Holds Promise Of Long-Range Missile Detection

By Philip J. Klass

Washington—New type radar which shows promise for detecting the firing of ballistic missile rocket engines and missile explosions at intercontinental distances has been reported by the Office of Naval Research.

The atmospheric backscatter data that our detect long columns of ionized gas produced by hot rocket engines and by nuclear explosions operates in the high frequency band (17 to 100 MHz) normally used for long-range radio communications.

High frequency radio signals propagate over long distances because the ionosphere reflects radio waves back to earth, then back to the ionosphere and back again to the earth, skipping around the globe in the fashion.

As earth moves with the ionosphere or the earth's magnetic field, the radio waves also are reflected back toward the source.

It is this backscattered energy, or echo, that is exploited in the new radar. The most prominent in short bursts of pulses is a two-echoing period in which to receive the back-scattered echo.

Each reflection off the ionosphere and off the earth produces a wave echo each displaced in time from the preceding one. When the solar wind strikes a large volume of ionized gas such as that produced by a rocket launch or nuclear explosion, it produces an echo with a distinctive energy pattern which can be distinguished from other atmospheric (weather) produced echoes.

The new radar concept, credited to Dr. William J. Thaler of the Office of Naval Research, was developed under the code name "Project Target" (7, 7). Thaler's Project Officer, going by the name of Nuclear Products Evaluation Division of AFCEC, Indianapolis, National Bureau of Standards, Lincoln Laboratories and the Naval Air Test Center.

The radar's advantages and limitations both stem from the fact that it operates in the high frequency band. Unlike more conventional radars which operate at higher frequencies, the new backscatter equipment is not limited to short wavelength ranges. Interception ranges can be achieved with extended range performance compared with that obtained by wave length limited ballistic missile detection radars.

One of the main system limitations is the fact that ion spots and solar flares severely affect the ionosphere's propagation characteristics, causing

complete blockage in high frequency radio communications. Presently, the new radar would be even more vulnerable than conventional radio communications. Furthermore, a small nuclear explosion in the upper atmosphere of the Project Argus type also could block an HF propagation for an extended period.

The radar also may be vulnerable in electronic communications. In playing a long-range HF transceiver in the vicinity of the source, launching site, an enemy could generate signals that could beat out the weak echo from rocket exhaust gases. It probably would be more difficult perhaps impossible to observe a large nuclear explosion.

One high frequency back scatter radar does not provide a rough indication of the distance and approximate distance of a nuclear explosion or rocket launch but makes it difficult in the propagation path to make it impossible to determine location precisely. By using several radar stations and triangulation, the target location could be established more precisely.

The new radar appears likely to find application in an early warning device to supplement other techniques such as the Ballistic Missile Early Warning

System and Project Merlin radars mentioned earlier.

The technique does not appear suitable for tracking ballistic missiles to confirm intercepts for launching intercontinental missiles since the HF signals do not penetrate the ionosphere, hence could not follow the missile after launch.

Dr. Thaler says that "prompting" of radars have been obtained over long ranges using broadcasting equipment. We are confident that a system capable of reliable detection over intercontinental ranges is feasible. However, we would like to increase radar's ability to track ionizing sources. The same technique has detected a nuclear explosion 5000 miles of rocket away, according to the Defense Department.

The idea of using the high frequency band for long-range radar is not new. Since about 10 years ago, Air Force's Rome Air Development Center sponsored development of an experimental HF radar. Tests indicated that the radar had little merit for use against stealth, the target of interest at that time. However, the equipment did find use in a series of experiments to determine what HF frequencies were best at any particular time for use for reliable communications with distant stations (8, 9).

Rome recently has taken a fresh look at HF radar for ICBM detection and is currently conducting an in-house investigation.

Semiconductor Advance Detailed

Pittsburgh, Pa.—"Transistorized surface tubes" which require no heater or filament power may result from a research division that develops semiconductor crystals can be made to conduct electrons, according to Westinghouse Corp.

Westinghouse reports that two of its research groups have demonstrated that a thin silicon carbide metal oxide varistor when voltage is applied across a diode in practice. Current densities range from 10 milliamperes/cm² to 100 milliamperes/cm² with a voltage drop of about 1 volt.

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so-called square律 application of a higher voltage to start electron emission from a magnesium oxide coated electrode. Dots in the flow of electrons after application of the trigger voltage to the metal of the Yang-Su tube stick to their surface, in low frequencies.

Electron emission from these dots is stimulated by the arrival of visible light in the form of electric discharges. Westinghouse reports, when the voltage applied across the semiconductor junction is increased to cause the breakdown of its initial electrical resistance. The starting spots measure only about 50 millionths of an inch in diameter with densities of about one microampere/cm² from each spot.

The fact that electrons are emitted from such dots suggests that they also find application in cathode-ray tubes to provide an extremely thin electron beam within 10 nm of the cathode focusing electrodes, not required.

Westinghouse says it is continuing its investigation of the new technique in its research laboratories, as well as working on its application to specific devices.

Congressmen, Retired Officers Termed Sources of 'Pressure'

B. Katherine Johnson

Washington—E. V. Higgins, former Assistant Secretary of the Air Force for Materiel and now executive vice president of Washington Electric Corp., told subcommittee of the House Armed Services Committee yesterday that Pentagon officials are under pressure "on procurement matters from both congressmen and from high-ranking officers."

Testimony by Higgins, Assistant Air Force Secretary between 1941 and 1945, was in contrast with that given by the subcommittee by a number of retired officers—including Adm. Arthur Radford and Gen. Gen. Dean A. Knudsen, both former chairman of the Joint Chiefs of Staff—who during their long service careers they have seen little or no evidence of former officers in Congress or trying to influence procurement.

The main complaint of Higgins' testimony, however, was on the part of military officers to reduce. He told the subcommittee that former officers have not only technical knowledge but also a major amount of executive, administrative, and policy know-how.

Higgins reported that it is not unusual for the practice in the Air Force to put a "park job" on the idea of contractors who had employed high ranking officers to use officers on their behalf. He said the job may be "a winning bag" because the Air Force "trained people to be sure that the fellows on the other side of the table and former Air Force commanders" are doing the same as former Air Force Secretaries. Higgins said it was obvious that "secretaries and senior officers were being put under pressure to bring about results." He said Pentagon officials "resent" the pressure of both congressmen and retired officers.

When he first left Washington, Higgins tried to be impartial as a sales committee subcontractor to the North American B-58 Mach 3 bomber (EW May 18, p. 25). Higgins admitted that he promptly contacted Pentagon officials to "help them lose our credibility."

It will then talk knowledge of our capability." Washington subsequently reversed the subcontract. Higgins summarized that as "a classic example of good acting."

Other developments before the subcommittee investigating allegations of contracts influence in defense procurement included

• Officials of Boeing Airplane Co. testified that they were forced to plan and refurbish the aircraft of the Boeing Air defense system being built for the Air Force in Washington, even though the force was "transformation" being achieved on behalf of the Army Douglas Nike Hercules air defense system.

C. R. Smith, then president of Western Electric Corp., whose Nike Hercules contracts totaled that a "big change" Smith and the Air Force had agreed to make a Western Electric subcontractor to Boeing. Higgins advised that in the fall of 1960 negotiations on a "water plan" for defense.

It also was developed at the hearings that Boeing officials had contacted the House Appropriations Committee.

Western Electric officials the Senate Appropriations Committee to correlate with the fiscal 1960 budget for defense. Neither company commented during the hearings, but simple language was used in the hearing documents to describe what was to go into the act.

A new investigation by STL is being built at Canoga Park, in southern Calif., about 35 mi distant from the headquarters of the Ringer Woodbridge. Its vision of TRW to further complete development of aircraft Wright reported STL's headquarters was just three miles distant. TRW clarity the director of STL.

Raytheon Wins Platform Contract

Washington—Raytheon has received a \$90,000 Air Force study contract from Wright Air Development Center for the company's proposed suborbital aircraft, the Raytheon, which can be used as a flying platform for surveillance radar or extended range communications system (EW May 18, p. 46).

Several companies have submitted various proposals to Raytheon, including Sikorsky and Westinghouse.

The platform, which could have up to 100 lb of payload, would be boosted up to 10 km by ground radio transmitter. It would use a small gas turbine, powered by compressed fuel and metal bellows and could be steered to allow maneuvering through arcs in the afterburner.

Once on station, the vehicle would be maintained aloft by mere atmospheric heating up to its afterburner.

Raytheon estimates that approximately 1,000 hp at the afterburner would be required to sustain the vehicle and an auxiliary atomic engine. The company estimates that approximately 20,000 hp (15,000 kw) of electrical generating capacity would be required on the ground based on available wind, efficiency of about 9.5%.

The latter figure represents 65% efficiency for the ground power transmitting antenna,

which is considered as a good return of its investment.

• J. D. Wright, president of Thompson Ramo Wooldridge, commented that we do have a problem here, in terms of Senior Technology. Laboratories was the laboratory's role as technical advisor to the Air Force in joint Thompson Ramo Wooldridge agreement to be completed shortly under the contract. As far as STL Army operating in the black, he said the corporation, we have no interest in it. But as a debt to our shareholders, we may have to become active in its management if it were to go into the red.

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J79: world's most-flown Mach 2 engine

General Electric's J79 jet engine has demonstrated its reliability by logging more flight hours than any other Mach 2 engine in the world. Typical of the J79's record is its outstanding performance in the Lockheed F-104 Starfighter—world record holder for speed, altitude, and time-to-climb.

Operational Flyby with the USAF's Air Defense Command and Twelfth Air Command demands the most of aircraft reliability and its engine. In the face of these requirements, the F-104 is compiling an outstanding record.

Because of its J79 engine's reliability, many more records are set.

More than 90% of total U.S. Mach 2 flight time has been logged by General Electric J79s—further evidence that it is today's top Mach 2 fighter-interceptor powerplant. General Electric Co., Cincinnati 15, Ohio.

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O'er the ramparts...

U. S. Army's

NIKE HERCULES...

Solid rocket motor built by Thiokol for Nike Zeus has produced greatest mass discharge rate and thrust of any single

Through the combined efforts of the U. S. Army, Western Electric, Douglas Aircraft, Thiokol, Chemical and other key members of the missile industry America is moving toward the nuclear ban of a critically needed anti-missile missile.

The Nike Zeus system — big brother to the Army's Nike Hercules which now stands guard over major population centers — is being designed to detect, charge and destroy attacking ICBMs many miles from their targets.

Assigned development of the boost for the Zeus, Thiokol has already designed, built and successfully test-fired a motor achieving over

Thiokol

CHEMICAL CORPORATION
Brandy, Penna.

Nike Hercules

NIKE ZEUS

solid propellant
motor ever test-fired
in the free world . . .
unleashes more than
400,000 lbs. of thrust
in static firing!

400,000 pounds of thrust — power enough to de liver the instant reach of high altitudes needed for effective defense.

While the Zeus booster stands as the most powerful solid propellant motor now on record it in no way represents the ultimate capability of present Thiokol facilities. Current capacity includes motors still larger — of ICBM and even satellite size.

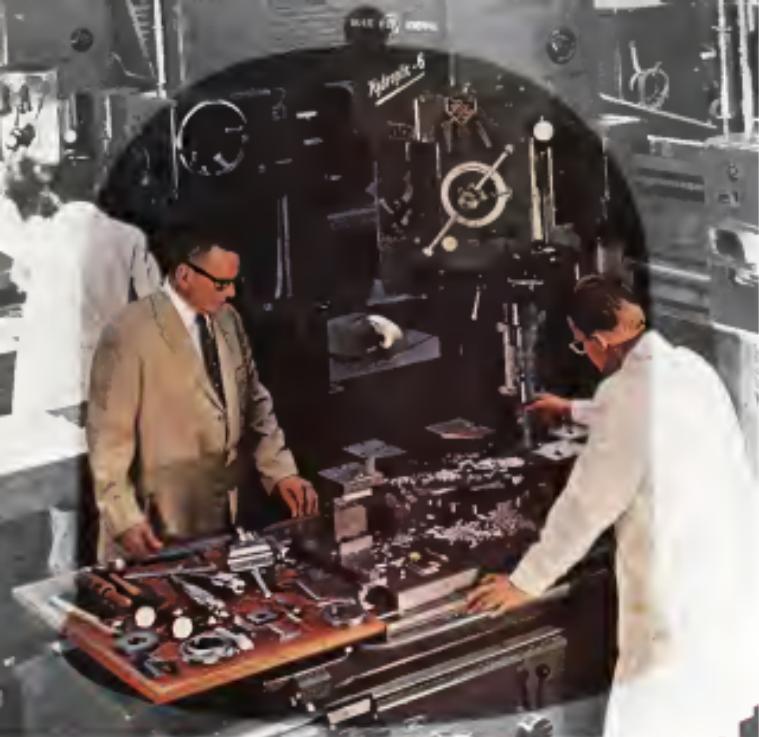
Under Army direction and in cooperation with Douglas Aircraft, Thiokol development of the Nike program has advanced the science of rocket propulsion.

DOUGLAS

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Left: H-4 Test Bench. Above: Two men at the workbench calibrating instruments in I.G. Works' precision laboratory.

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weight consider, narrowing antenna of above the wave diameter.

Minimum energy required to be transmitted would be needed to plane elements which would convert it to coherent. Compressed air or gas heated to these elements would then drive the turbines which supply power to the radio tip jets.

In addition to the fuel carried for initial liftoff and climb to station, the vehicle would carry a small reserve to take it over in the event it lands out of control with the ground-to-space link still active.

To hold down the weight of the vehicle's payload, Rutherford proposes that the flying platform and its radio transceivers can ride on the second stage, deployed early, to increase payload capacity and to increase survival of a complete aeroelastic failure. The radio signal would be generated on the

ground and transmitted to the search antenna, and the received radio signal would be retransmitted back to the ground. The Rutherford tubes used to supply power tend themselves to various forms of modulation permitting the radio pulse-form to be superimposed on the power base, thus extracted at the vehicle and routed to the search antenna.

A series of flying platforms could be used as a chain of automatic repeaters to provide remote communications in the Arctic or over the Atlantic, Rutherford says. At microwave frequencies, 30 arc bandwidths can be obtained which would provide more reliable communications than can be obtained with the high frequency band used for long-range communications and without the frequent outages due to ionospheric disturbances.

Unions Outline Industry Demands

Seven-point bargaining program for 1963 was adopted by main representatives of aircraft, missile, and related electronics workers at the International Association of Machinists and United Auto Workers joint conference in Kansas City, Mo.

The seven basic proposals, which will be presented at the next round of negotiations with major employers in the aerospace industry, are:

- **Wage increase.** The following principles will be adhered to in recognizing previous contracts. The plus shall be 100% employee financed, retroactive funding of benefits will be provided on a tested basis, all aspects of the plan will be paid off after 1965. Protection should be made for voluntary retirement before age 65. Workers should be eligible for \$7,000 lump sum benefit on death or disability retirement.

- **Severance pay.** Any employee who is laid off or terminated and who has one year or more of service should receive severance pay, proportionate to this length of service, in addition to payment for any unused portion of vacation or sick leave allowance for which he or she is eligible. Severance pay shall be such that it's pay for each month of service.

- **Relocation pay.** Any employee whose work site is transferred or moved from his or her place of residence should be entitled to pay for travel, house moving, compensation for the expense of maintaining two houses, or for disrupting and leaving his home.

- **Union security.** Adherence of union shop clause on board in the aircraft and missile industry is a basic and serious objective for both unions.

- **Hospital, surgical and medical insurance.** There should be established a sound and adequate basic benefit which will satisfy the medical and social hospital, surgical and medical requirements of the employees...

AIRPORT WIRE, August 17, 1959

News Digest

Air Force Cosmic Able 24-D launched a heat sink, nose cone about 5,000 feet above the Atlantic Missile Range last month at the third successful test of current heat sink modifications. One more test shot is scheduled, but the success of the last three is expected to lead USAF to launch an Able-D within a few weeks from Vandenberg AFB to establish the initial operational capability of its originally scheduled for July 1 and delayed twice in succession of Atlas test failures (AW July 6, p. 27).

Boeing Airplane Co. has consolidated its Seattle and Spokane Aircraft Division and Systems Management Div into a single new Aero-Space Division with Boeing Vice President Jack A. Wood as general manager (AW April 27, p. 10).

Prudhoe Bay Corp. reported a first half net profit of \$245,400, compared to a net loss last year of \$5,000,000. Comparable sales were \$66,590,000 this year and \$67,801,000 last year.

Commercial Aircraft Engineering Corp. reported first half earnings rose to \$5,326,081, or 54 cents a share. Total 1961 sales of \$10,204,000 at 87 cents a share last year were a \$73.9 million sales increase from \$10,733,002 to \$83,11,466.

Pratt & Whitney Co. will design and build a "New A-7" jet fighter jet plane which will make the plane to take up "extreme short takeoff and landing." Contract was awarded to Grumman.

Spyer Composite Co. is developing use of the liquid power radio transmitters to be used for target tracking in the Army's Nike Zeus anti-ballistic missile system under a \$4 million contract with Bell Telephone Laboratories.

Airway Aviation officials this week will start evaluation of the Sikorsky S-58 in long range under contract calling for several months of evaluation at Ft. Worth, Tex. Ft. Bragg, Ga., and Ft. Dix, N.J.

Gen. Motors Genda, chief of staff of Japan's Air Self Defense Force, and a team of six officers are in the United States for a four-month inspection tour to see the Grumman F11F-1, Lockheed F-104, Northrop F-108 and Convair F-102 and F-106.

Fordham Aircraft Manufacturing Division W. E. W. Paine and Assistant Managing Director E. N. Egan will be leaving the company after its acquisition by Hawker Siddeley (AW Aug. 5, p. 50).

Bilaterals Strengthen Foreign Carriers

BOAC, Air France gain round-the-world routes to meet competition from U.S. jet operations.

By Robert H. Cook

Washington—Foreign airlines are moving aggressively to meet the competitive threat posed by the introduction of jet operations over the global routes. U.S. flag airfares are becoming expanded traffic rights under the bilateral agreements these governments have with the U.S.

White House approval last week of a Tokyo stop for British Overseas Airways Corp. via the broad collection of what U.S. carriers fear may be a trend toward wholesale demands by foreign airlines for new routes to this country.

BOAC's authority, followed on the hook, was won by agreement to expand its Pacific rights. At Aug. 14, p. 39, Together, these route extensions from the hook to the east round the world, services to remote areas with U.S. carriers at first when bilateral negotiations are just making with global service rights practical.

BOAC will take immediate advantage of its new authority by starting a global service Aug. 22, with two Britannia 112 turboprops. Tokyo is a transit center in London and Hong Kong on New York, San Francisco, Honolulu and Taiaco. These flights will connect with the British airline's Coast 4 package service between London and Tokyo through the Middle East to complete the global service.

Air France will make its first round-the-world service when it begins operating the Paris-Tokyo route.

Air France will start round-the-world services on new polar routes between Paris and Los Angeles and vice versa. Boeing 707-320 transports are delivered, and the French carrier plans to establish round-the-world service in 1970, when Interavia's Asian-Pacific combination begins flying its Douglas DC-8s into Los Angeles over its route from the South Pacific.

State Department Stand

Department of State officials, who say that a complete reconstitution of the bilateral route hook, resulting in a loss of Tokyo-Pearson round-the-world rights for U.S. carriers by 1970, have informed the two trans-Pacific bilateral route negotiations, including the U.S. They point out that French says no to demands for "double route" status, or duplication of every route granted U.S. carriers. The point also fails to give the French the route they wanted most—return to the West Coast from New York.

While Air France has gained entry to the U.S. West Coast with a polar routing, an Air France spokesman con-

tinues Los Angeles route with Boeing 707-320s. McDonnell, Pan American, World Airways plan to introduce foreign services over the Los Angeles-Pearson route by Aug. 26. This route also is served by Trans World Airlines and Scandinavian Airlines Systems, and BOAC and Lufthansa also have rights to it.

BOAC Reaction

Yokohama spokesman said the airline is "delighted to have, at present at least, the Tokyo stop but turned the four-month delay with mounting White House opposition "utterly unacceptable."

BOAC estimated that the delay cost it \$7.7 million in lost revenues. Air France spokesman said managed services for the route means a Tokyo stop would not have been necessary last March if BOAC had insisted. U.S. approval is awaiting more than a fortnight. In addition to revenue losses, BOAC had to rechart advanced fare bookings, credits over the Tokyo-San Francisco route.

The carrier also is forced to hold ship crews and their families idle at Honolulu throughout the course of negotiations, between the two countries in expectation of a pending decision in the case.

As approved by the Civil Aeronautics Board, BOAC will authorized to provide Tokyo-Honolulu and the reverse route, but U.S. crews were given an extension. The Japanese government forced the British carrier to switch its schedule pattern over the route to a twice weekly basis.

Japan Air Lines spokesman says the airline has no plans to increase its once weekly flights in this country as a result of the BOAC route. However, the carrier is negotiating for the lease of a Boeing 747-100 from Continental Airlines to meet competition from Pan American and BOAC (see p. 43). Pan American's plan to begin service in 1970 would add services between Los Angeles and San Francisco, the BOAC route, as well as those three cities and New York.

The airline has leased 1,000 lb. of Boeing 747s and completed a period of nearly 14 hours practice to the aircraft. Its pilot fleet totals 280 hr. at 707 time. The plane was reported to be back in service in about three weeks.

However, the carrier is not convinced that the threat of direct competition with the British airline is great. While BOAC will fit a mid-Pacific route to Tokyo as opposed to Northwest's routing on its Pacific polar route via Anchorage



707-420 Will Enter BOAC Service

First Boeing 707-420 intercontinental transport is the 318 707 to be produced at Everett, Wash., by Boeing's Transport Division. The aircraft will serve British Overseas Airways Corp. service.

Delta Proposes Low Coast-to-Coast Fare

Washington—Delta Air Lines has proposed a reduced fare "thrufares" service on a east-west coast schedule as one of its major plans for improved service if the carrier is granted West Coast routes in the Southern Trans-Pacific Service Case.

Starting at Cal Airways' Board hearings last week, the airline said its plan also will call for daily nonstop schedules linking Atlanta and Miami with the West Coast and bi-daily all-cargo flights between those points with piston engine planes.

The airline has requested an extension of its present route system beyond Dallas, Ft. Worth and Houston to Los Angeles, San Diego and San Francisco. Delta also proposes to link San Jose, Hawaii, Guam and other cities on its Caribbean routes with the California cities through a linking of New Orleans.

Delta said the Board first plan is to offer 210 million miles round passenger miles in 1970 and expects a profit of \$1.56 per plane mile on the planned service. Using DC-10s, a combination of 47 three-class and 18 first class seats, maximum passenger revenue per plane mile is expected to be \$3.85.

Proposed thrufares fares would be about 1.87 cents per passenger mile, compared to current fares of 6.6 cents per plane mile and 4 cents per revenue mile.

Based on an average trip length of 745 mi., Delta estimates the cost of the reduced fare service would run about \$3.15 per plane mile, and breakeven passenger load factor would be 51.89%.

Cargo flights planned by Delta would use DC-6As on an initial schedule of two daily flights connecting Miami and Atlanta with San Francisco and Los Angeles, with additional scheduled as long-haul traffic increased.

Braniff, Continental Report Profit Gains

Washington—Midwest earnings reaped from trunk airline contracts to regional lines, with Braniff Airlines' net income increased 187% over the first six months of last year, and Continental Airlines operating revenue reaped a gain of 48% in the same period.

Braniff recorded a net income after taxes and capital gains of \$870,609, based on operating revenues of \$361,731,763 and total expenses of \$313,466,314 for the first six months of this year.

In the same period of 1969, the carrier earned a net profit of \$87,669 on operating revenues of \$313,283,518 and expenses of \$313,644,544. Depreciation and amortization costs during the 1969 period were \$2,789,912, compared to \$3,601,435 for the six-month period ended last year.

Continental had a net income of \$100,000 during the period, compared to a net loss of \$335,000 for the first half of 1969. Operating revenues increased to \$174,460,000, compared to \$123,715,000 during the first half of 1969. Total expenses advanced from \$174,770,000 to \$165,944,800 in the same period.

Much of the rise in revenue and other expenses this year was explained by a net capital gain, after taxes of \$1,028,000 from the sale of aircraft.

First *electra/JET* service along the Pacific Coast



LATEST IN A 33-YEAR SERIES OF AIR TRAVEL "FIRSTS" is Western Airlines' new *electra/JET* service. Fastest and most comfortable flying ever between Seattle-Tacoma, Portland, San Francisco, and Los Angeles! The revolutionary *electra/JET* is big, powerful, jet-just—and its combination of jets and propellers has some wonderful advantages over ordinary jets. The ability to take off and land more quickly...faster climbing to cruise altitude...greater nimbleness on the ground to cut taxi and loading time. As a result, the *electra/JET* is one jet whose gate-to-gate timetable really tells the truth! Now, more than ever, Western's the wonderful way to fly!



"First in the West with *electra/JET*"



Japan to Lease 707 for Pacific Jet Race

By Glenn Gauthier

New York—Japan Air Lines is negotiating with Continental Airlines for the lease of one Boeing 707-120 jet transport to enter the Pacific jet competition. AVIATION Week has learned if the deal goes through, expected Japanese interest could move closer to matching the Sept. 5 transpacific in August date Pan American World Airways has set for its Boeing 707-320 aircraft.

Continental has been involved in several jet, the first just in its initial form only. But the airline had optioned a fifth 707-120, and that option is now being exercised, and now is available at Boeing's Renton, Wash., plant. It is fitted with a Continental interior and an extensive configuration.

Japan Air Lines has ordered four Douglas DC-8 jet transports, the first of which is scheduled for May, 1962, delivery, and arrival with the airline is expected to begin some time before July, 1962 (AWW June 13, p. 38). Yet in the meantime, often on the surface competition across the Pacific, would give a considerable lead on the Japanese carrier. Pan American reports is begun with two San Francisco-Honolulu and two Los Angeles-Honolulu-Tokyo flights a week and that schedule will extend through the winter season.

Midwest Orient Airlines has ordered five DC-8s for 1962 delivery and hopes to start service early next year. British Overseas Airways Corp. has announced plans to shift transpacific schedules next Spring with its Bristol 707-100B transports, which will connect at Tokyo with BOAC Concorde 4 jets to provide a round-the-world business-passenger service.

Continental Crews

AVIATION Week learned that word use of Continental crews is continuing. In that regard, Japan's own aircraft will be leased to a least partially replace the Continental personnel after the aircraft are delivered. Pan American's new operator is prime potential transpacific service partner, with U.S. 8-passenger aircraft. U.S. 8-passenger aircraft pilots probably will be used on initial DC-8 runs.

The Japanese airline now flies most weekly round trips between the U.S. and Tokyo, most of them with Douglas DC-7C equipment and the rest with DC-6Bs. It serves the three Pacific Coast gateway cities of San Francisco, Los Angeles and Seattle.

Service with the Continental 707-120 would undoubtedly begin at Los An-

gle or San Francisco, and possibly alternate between the two cities, with a third to one of Honolulu or Seattle-Tacoma.

The lease with Continental probably will extend past the start of DC-5 service. Such an arrangement would add to Pan American's jet capacity while DC-5 is now being phased in and would provide additional new training opportunities. It appears likely that package consideration that all-Japan lines will be flying the 707 in soon as practicable.

Previous Lesson

If the Pan American deal is consummated, it will mark the third instance of an airline, Pan American, with two leasing recently to enter the transpacific race and now is available at Boeing's Renton, Wash., plant. It is fitted with a Continental interior and an extensive configuration.

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Continental's first delivery jet will be able to handle its needs for the immediate future, according to the air-

line. Since start of jet service, June 8, between Los Angeles and Chicago, Continental has carried about 36,000 passengers on the aircraft. It has been flying this, narrow-coupled route daily between the two cities, and was scheduled last week to add two more schedules, one with a stop at Denver, and the other with a stop at Kansas City. On Sept. 5, the airline plans to add a second Chicago-Denver-Los Angeles schedule, for a total of six round trips daily between the two terminals.

Continental has been averaging 314 seats of daily utilization with six jets plus its scheduled service. The fourth jet plane will take over on the flight, increasing utilization to 340 percent of three.

The airline says its jet utilization, using Continental's new eight-jet fleet, during summer (AWW June 15, p. 38), are averaging 15 seat through the checked bag at Chicago. Largest checked bag, according to the carrier, took 2 men.

By Sept. 5, Continental will be operating more than 307 of its dash 707s with various powerplants, including the Boeing jets and 15 Vicks on Vickers turboprops.



Boeing Tests Fifth Pod on Quantas Jet

Quantas Empire Airlines Boeing 707-320 jet transport, carrying six Quantas & White's P-14C corporate passengers, in left wing in a fifth pod, taken off on a test flight from Boeing Field, Seattle, Wash. Boeing claims and others does not uniformly offer flight handling qualities. Avro's is not a 707-420 as was previously reported (AWW Aug. 16, p. 37). Below: Quantas "City of Canberra" Biplane is shown on stand at Honolulu, Hawaii, airport. Avro's Avro 707 will start to service between Sydney, Australia, and San Francisco, Calif. Transpacific flight took 19 hr. 45 min. to 3,830 mi. route.





Airline profit-makers

The Boeing jetliners shown above are designed for profitable operations over all air routes. From short-haul routes to very long overwater stages.

The outstanding earning power has already been demonstrated by the 707. Since going into service last October, the Boeing jet has attained an impressive load factor of 90 to 97%. Operators consider it to be the most profitable jet in airline history.

Within weeks the 747 Intercontinental—the world's longest-range jetliner—will begin commercial operations. With a range of more than 5000 miles with full passenger payload,

it will fly nonstop over the longest range of airline routes, at cruise speeds above 600 miles an hour.

The 720 is the fastest aircraft in its class, with a cruise speed of 644 miles an hour. Backed by Boeing's unequalled strategic experience, the 720 is an extremely versatile jetliner able to operate profitably over short, medium and long-range routes.

Boeing jetliners, now in scheduled service in United States and international routes, are demonstrating tremendous earning power, extremely high initial utilization and unprecedented public acceptance.

These aircraft have already started flying you.

AM FRANCE AIR FRANCE AMERIQUE
SUD AEROPORT CHICAGO
COPAN BRESIL UTRALIA
PAT AMERICA QATAR AIRWAYS
SINGAPORE AIRLINES
VIAIRIA NAME AIRWAYS

BOEING

Family of jetliners

Senate Approves \$25 Million For MATS Jet Transport Fleet

Washington—Senate has voted \$30 million over a supplemental appropriations bill to begin a comprehensive modernization program of Air Force's Military Air Transport Service.

Previously, both House and Senate had turned down Air Force's request for \$33 million for 10 cargo jets for MATS in voting the fiscal 1969 supplemental for Department of Defense (AW Aug. 10, p. 26). An Transport Area sought the project, claiming MATS would use the jets in conjunction with commercial operations. However, DOD and its supporters on Capitol Hill apparently decided to withdraw after final passage of the defense bill.

The \$30 million was approved after a brief presentation to a Senate Air appropriations Subcommittee considering supplemental appropriations by Sen. Howard Cannon (D-Nev.). Cannon resolved his presentation with a letter from Air Force Secretary James H. Douglas supporting the measure.

As outlined by Cannon, the three steps in the MATS modernization:

- **First**, "a high-speed short-haul" which would consist of one or three squadrons of Boeing 707, DC-8, or Convair 990 aircraft in a cabin configuration for strategic transport. The Air Force's \$15 million of the \$30 million would be available for these configurations.

- **Second**, a large, fast, long-range "overwater" aircraft for cargo handling and troop transport. It would replace the propeller-driven C-124, of which MATS now has 140. Cannon and his replacement would "very possibly" be something like the C-900. The additional \$1 million in the \$30 million bill is intended for the development of an advanced transport for the new "overwater" aircraft.

- **Third**, completion of the program for the Douglas C-133 turboprop cargo aircraft. The C-133 has been held up by a scheduling problem to be completed in three to four years.

An AT&T spokesman suggested that Air Force "shouldn't" on the \$3 million for the long-range cargo aircraft to gain support for the jet cargo aspect of its MATS modernization program, particularly the support of Sen. Mike Mansfield (D-Mont.). Mansfield has been pushing for the development of such a plane for commercial as well as military cargo operations. Mansfield estimates that, at an economic plane, such a developed aircraft could operate for about 45 cents a ton-mile, about 300 of those could be used in commercial operations (AW May 18, p. 25).

In May, Assistant Secretary of Defense Perkins McGinnis informed Mansfield that Defense was sending with the Federal Aviation Agency to the development of a commercial-interline cargo aircraft.

Last week, after the Senate voted funds for USAF to undertake the development, Federal Aviation Agency Administrator Edward Quisenberry ordered a simplified press briefing, an FAA's progress in development of an economic commercial cargo plane.

At the subsequent briefing,

Mansfield opposed the cost control of the development with USAF—3 years earlier, from the need that he had had in the past, that the Secretary of the Air Force, and some of his people, have ever been interested in delaying or preventing a certain type of cargo plane while the cost factor in developing such a plane for ton-mile is the most important element.

Mansfield said: "The most important element for the software, because they are seeking performance, and in getting performance free, automatically get a lot of gadgets, added equipment, built-in headways, and things of that kind."

Cannon argued that USAF has "several proposals" for the commercial-interline cargo aircraft.

American Claims Revenue-Miles Peak

New York—American Airlines flew \$18,354,000 revenue passenger miles last month, a total the airline said was an all-time monthly high for over 100 aircraft in service. The fare was about 20% higher than the July, 1958, total and, for the first time in American's passenger experience, the July total logged the June total. June usually is the airline's biggest profit month.

Other months were reported in air freight, air mail, up 25%, and surface mail, up 15%. American said its June fare fleet, now totaling 25 Boeing 707, 200-220 and Lockheed Electra turboprops, was largely responsible for the July record.

American last week announced new extensions of its various aircraft leases. By Aug. 31, when the new packages will be completed, play off for new jet aircraft which include two Delta-Los Angeles flights each, Boston-San Francisco service in Chicago, and Chicago-Dallas round trips, and a second daily Baltimore-Los Angeles round trip.

New Electra services under the plan will include Chicago-Detroit flights, a Detroit-Chicago-Dallas-EU. Four weekly, and an increase to twice daily round trips to New York-Cleveland service.

Slick Places Order For Three 1049Hs

Slick Airlines has placed an order with Lockheed Aircraft Corp. for three 1049H Comsatcom nonstop cargo-passenger aircraft. Contract value is about \$7 million, including space. The first airplane will be delivered around the start of next year.

The cause in re-establishing the carrier as U.S. domestic air freight carrier, was started by the need that the Secretary of the Air Force, and some of his people,

have ever been interested in delaying or preventing a certain type of cargo plane while the cost factor in developing such a plane for ton-mile is the most important element.

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27 Airlines Bid For MATS Contracts

Washington—Twenty-seven commercial airfares have submitted bids to Military Air Transport Service for trans-Pacific cargo and cargo to Europe, Alaska and the Far East areas during the year starting Oct. 1.

Considered by MATS the largest single military cargo contract ever awarded, award of the contracts totals \$18,000,000, a total the airline said was an all-time monthly high for over 100 aircraft in service. The fare was about 20% higher than the July, 1958, total and, for the first time in American's passenger experience, the July total logged the June total. June usually is the airline's biggest profit month.

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Low-density European American contract for 24 Avro 748 Lockheed DH-121 jet aircraft worth \$87 million was signed last week. The order holds an option for an additional 32 aircraft.

A 12-month contract deal (AW July 17, 1958, p. 41) was ousted by specification changes reflecting the use of the aircraft.

BEA Signs Order for 24 Triple-Turboprop DH-121s

London—British European Airways contract for 24 Avro 748 Lockheed DH-121 jet aircraft worth \$87 million was signed last week. The order holds an option for an additional 32 aircraft.



BREAKER STEP around AW 500 nose landing gear door prevents strong turbulence flow from entering fuselage on tail plane.

Argosy Modified to Cut Aft Turbulence

By John Treadell

London—With one-third of the Aérospatiale-Whitworth AW 500 freighter helicopter design complete, the body扁bod扁 design experts expect full U.S. and British certification could come in as early as March. This is two months ahead of a schedule prepared nearly two and a half years ago when the project was started.

Using the first four production aircraft, the company has logged 540 flying hours since the maiden flight six months ago. Only three flights out of a total of 361 were canceled for maintenance.

Otherwise, Deputy Chief Engineer David Woodley told Aviation Week, modifications have been minor, and the behavior of the aircraft varies which have been fully installed in all four aircraft now has been good.

Cockpit Slope

Because of the top fuselage flow is fine, Woodley said, and in the midsection step down slope of the cockpit rear and to the high wing position also the fuselage in a run back condition now was particularly susceptible to vibration due to fluttering produced through lack of the damping influence of an integral cargo bay.

Because of the fuselage top flow, the strain underneath pressure film along the bottom of the cockpit caused the safety gear and during the particular takeoff in the tail plane. The vibration is consistent on speed and appears to be in the 7-10 cps band.

Concert attempts to mitigate the flow include vortex generators on the forward slope of the cockpit blister and a buster strip around the lower part of the fuselage and dome which impacts air off flow from the bottom fuselage surface. The film weight is nearly 1000 lb, with a larger wing



TWO AW 500 can load palletized freight in a short time, aided by roller strips on loading



LOAD HEIGHT loading floor speeds cargo operation (left); at right, palletized freight is lowered to floor by hoisting platform.

unit which will be able to reduce the loading time to 10 minutes.

In the basic aerodynamic phase of the test program which has now been concluded, all the systems have been cleared, and the aircraft has flown at maximum weights over its full range of gross weight. Details of the 32,000 lb aircraft is painted up to its ability to hold 75 lb. with full flap, loading gear down and one engine feathered.

The company is now proceeding with the detailed evaluation of performance, 4000 hrs.

Typical trials are due to start in September.

In the static test program, all the critical landing units have been covered.

and fatigue testing are under way in a cost of about \$100,000, a static test of strength 5,000 lb. is now complete.

Following acceptance of a subcritical certificate of airworthiness by the Air Ministry, Whitworth has been using the fourth production aircraft for demonstration flights to refuges and for freight handling exercises. Fired out in a mixed passenger freight version with seating for 15 passengers, it will later be used for motor-proving trials. Seats which fold flat against the sides and removable bulkheads enhance the rapid convertibility of layout.

Company's palletized freight system is based on use of lightweight metal strips mounting small rollers which are belted to the freight floor. Pallets can be stowed, transported or towed type. Company's studies, Woodley claims, prove that the added weight of the palletizing equipment is a small sacrifice for the availability and increased loading times obtained.

Aviation sales tour of the U.S. is scheduled for early 1960. Company now has expressions of interest for about 40 aircraft, but no signed contracts.

Riddle Aerobus has ordered four AW 500s, with Rolls-Royce Dart engines (AW June 22, p. 112).

Company is negotiating with British Ministry of Supply for a further order of about 12 aircraft and envisages future development of up to 110,000 lb gross weight.



VORTEX generation (left) are installed on cockpit blisters to help alleviate buffeting at low.

The man:



A number of an Army Medical Corps air evacuation team. He belongs to one of the Army units which rush the sick and wounded to general hospitals by air. Fast evacuation of casualties to hospitals has dramatically reduced the number of fatalities in "lethal fire" or general warfare.

The mission:

In addition to its priority mission of supporting the strategic striking forces, Military Air Transport Service also has the humanitarian mission of air evacuation—high-speed movement of wounded from base hospitals in the theatre of operations to the finest medical facilities.



The Douglas "Jettmaster," proposed military version of the DC-8 Jetliner, with a cruising speed of almost 500 knots. It could wing 80,000 pounds of cargo, or 175 combat troops, or 152 litter patients with medical attendants between the U.S. and Central Europe in 7 hours.

The means:



Danner et al.

DOUGLAS

The Nation's Partner in Defense

Airline Traffic—June, 1959

Not applicable.



BEING TOWED to runway at N. Y. International Airport for engine runup, Tu-114 shows clean cross-section in our view, rocket engine deleted at its swept wing. Large size is apparent when compared with person walking turboprop transport to landing.

Design Details of Aeroflot Tu-114 Turboprop



CLOSELY COWLED frontview cowling. Turboprops develop well over 12,000 bhp each, according to the Russian and our IFI tape test and testifies. Blade of 15 1/4" diameter reversible contouring prop is clearly foret seen spinner. Propeller approach have no blades, save a pin was observed fitting linked together when a horn sprang up suddenly.



LARGE inner engine nacelle (left) houses large four-bladed prop which is rotated using two big electric motors on each well. Gear assemblies half-circle in retraction cycle according to Russian. Nose gear (left) is hydraulically retracted, as is front-wheel tail bumper. Russian engineers make up gear steady from several components, weld them together, rather than spend time designing single-piece unit. Thin vertical member between fork was welded, put about 12 ft long. Closeup (right) shows main landing gear track facing forward, wheel, end of wheel axle. Chordwise wing spar (center) lower left is located between aircraft wing roots. Main gear bogie has two wheels, like racing carts. Extra gear service is used when aircraft Tu-114, rather than operating on homogeneous headed structures. Tail assembly (center right) features movable horizontal stabilizer, markings indicating travel soon as left side side, pre-heat of stabilizer leading edge. Control surfaces are fitted with hydraulic boost system.



The Breakthrough Air Freighter that *smashed* the cost barrier!



CANADAIR JET-PROP CL-44

*...the first aircraft designed
specifically for the air cargo industry*

The jet-prop CL-44 was designed specifically to meet the immediate requirement for an aircraft that would significantly lower the cost of cargo movement.

In this highly important role, the Canadair CL-44 breaks through the transportation cost barrier and will revolutionize the whole air cargo market. It provides direct operating costs of less than 4½ a ton mile and breakeven load factors as low as 28%, which are both lower than those of any other aircraft anywhere in the world.

The swing-tail CL-44 is already in production for the largest air cargo carriers in the world—Seaboard & Western Airlines Inc. and The Flying Tiger Line Inc.

- Payload—64,000 lbs. • Range—3,000 mi. • Speed—400 mph
- Engines—4 Rolls-Royce Tyne 12 • Cabin capacity—7,391 cu. ft.
- Floor loading—300 lbs. per sq. ft. • Passengers—as low as 183
- Span—142 ft. • Length—128 ft. • Cabin length—98 ft.
- Gross weight—205,000 lbs. • P.A.A. takeoff field length—7,550 ft.

The Canadair CL-44 is also available as a passenger or as a convertible passenger/cargo aircraft.

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AIRLINE OBSERVER

► Watch for Iberia Air Lines of Spain to announce the purchase of at least three Boeing aircraft within the next few weeks. Preliminary order will be for Douglas DC-8s, although the company also has been looking at both Boeing and Convair jets. Order would be placed by the National Festival of Industries, owner of the airline, and is reported awaiting the official funding of Spain's Council of Ministers. The aircraft would be used to meet expected jet competition from both European and South American carriers and would be placed on Iberia routes to New York, Mexico City and the Caribbean.

► Hawaiian Airlines has signed a credit agreement for \$1.75 million that will permit the airline to complete its co-operative program with the purchase of four additional Convair 580 aircraft. The program, which now spans four Convair 580s, seven Douglas DC-9s and one Douglas DC-8C, plans to place out the DC-9s within the next two years. Terms of the co-operative will call for Iberia to loan of \$570,000 cash from the Bishop National Bank and the Bank of Hawaii, with the \$1.75 million balance to be provided by the First National City Bank of New York. Loan is scheduled to be activated by Dec. 31, 1965, and was obtained without a guarantee from the Civil Aeronautics Board.

► Trans-Canada Air Lines has completed negotiations of airborne weather radar on its fleet of 50 Vickers Viscounts and 13 Lockheed Super Constellations. Cost of the refit program, which began last September, is estimated by TCA at \$1.5 million, with Bofors and RCA radar units costing between \$16,000 and \$17,000 each. Modification and installation expense for each aircraft is about \$15,000.

► Two truck airlines have introduced computer ticket plans on an experimental basis and may expand the new service if it proves successful. Capital Airlines has installed its first computer ticket books on sale, effective Aug. 2 over its Chicago-Minneapolis-St. Paul route. By the time the season begins, the airline had sold \$325,000 worth of computer tickets, according to Walter H. Johnson, senior vice president of marketing. American Airlines' first computer tickets were scheduled to become effective last Saturday over the Boston-New York-Washington route. They will be paid for in units in either direction. Each airline sells its computer tickets in books of 10. Blocks of the tickets book space by telephone and write flight number, date of departure and time of arrival—on, in Capital's case, a code number—on the flight number. Then ends the transaction until the passenger purchases his coupon upon boarding the flight. Johnson and Capital expect to sell 100,000 units over the first year and up to 50,000 by the end of the year. The plan is to have Capital's telephone "to make an reservation easier to use and more convenient to buy." American expects to evaluate the merits of its computer service at the end of October and then possibly apply it to other cities.

► Canadian Airlines is providing free transportation between Chicago's Midway Airport and O'Hare Field for intra-city passengers connecting with the company's Boeing 707-130 flights between Chicago and Los Angeles.

► Vickers-Armstrongs, Ltd. says U.S. operators of Vickers Vanguard turboprop transport could bring an airline a potential profit of \$6.5 million annually per plane. The British manufacturer bases its profit picture on U.S. costs over \$300,000, stage lengths, a beginning load factor of 48.8% by 1962 and attainment of an 86.5% load factor by 1968. Applied to European routes, Vickers says the Vanguard would earn a per plane profit of more than \$19 million in the same time period.

► British European Airways' net profits for fiscal 1958-59 dropped more than \$1.23 million from the previous year and totalled about \$644,000, according to a preliminary financial report by BEA chairman Lord Beaufort of Knebworth. Profits before paying interest charges on capital were about \$3.6 million. Passenger traffic for the last quarter of the current fiscal year, however, was up 22% above that for the same period of last year.

SHORTLINES

► The Express Division of the Robin Express Agency reports that it handled 7,945,724 shipments on U.S. scheduled airlines during the first six months of 1958, a 5.7% above that for the same period last year. Total tonnage for the period was 10,295,522 lbs., as compared with 8,936,732 lbs. for the last six months of 1957. Total value totalled \$6,693,615, a 22% gain over the 1957 period.

► Allegheny Airlines carried 58,797 passengers on its 16.2 million revenue passenger miles during July, a 27.5% increase for the latter over July, 1958. Air freight and express bookings totalled \$77,000 D., with air freight up 76% over July, 1958.

► Montreal Central Airways is now operating a Vickers Viscount V-815 on regular flights on its Montréal, New Brunswick, Gaspé, St. John's, and Gander-St. John's Newfoundland routes. The airline plans to use a combination freight-passenger configuration on the flights.

► Mexicana Airlines (CMA) is scheduled to begin British Airways non-stop service between Los Angeles and Mexico City on Sept. 1. The Transmex will operate on Wednesdays, Saturdays and Sundays with CMA's Douglas DC-6 aircraft operating on the other four days of the week.

► Northwest Airlines carried 47,215 revenue passengers in July for a 30.2% increase over July, 1958. Load factor for the month was 33.1, a 6.1% increase over July, 1958.

► Northeast Airlines flew 165,218 domestic passengers 130,126,649 revenue passenger miles during July for 16.3% and 18.6% increases respectively over the same month of last year.

► Seven Star Airlines, recently granted initial authorization of the Federal Aviation Agency to operate restricted air services on a world wide basis, has purchased two Douglas DC-8 aircraft. The aircraft, which was manufactured in France, flies in New York and Australia. Seven Star purchased the DC-8 from Pan American Caribbean Aircraft, Inc.

► United Air Lines has begun Chicago-Minneapolis daily round trip service using Convair aircraft. The carrier has reengined Douglas DC-7s, dash 8 through service from both Philadelphia and Pittsburgh to Las Vegas, a nonstop DC-7 service from Salt Lake City to San Francisco and one day round DC-7 service from San Diego to Chicago.



SYMBOL OF A NEW SERVICE TO AVIATION

Frederick B. Ayer & Associates, Inc. is the world-wide aircraft center where airline operator or corporate user can complete all the complexities of an aircraft transaction. All types of Douglas DC-8s and Convair, units or entire fleets, are offered for sale or long- or short-term lease, as well as a variety of other pressurized aircraft available through Ayer's equipment exchange and trade-in policy. Ayer's agreements with American Express and A/Research provide world-wide financing, custom interiors or complete modifications. For Ayer customers there is also crew training, plus counseling on engineering, operations and insurance. Let this symbol of a new service to aviation be your symbol of complete satisfaction. Frederick B. Ayer & Associates, Inc., World-Wide Aircraft Center, 250 Park Avenue, New York 17, N.Y. MU 2-1800.

Simulators Train Mercury Space Pilots

By Craig Lewis

Langley Field, Va.—Mercury capsule will use a series of simulations and training techniques to gain proficiency with the equipment that will be used and become familiar with the controls they will want when they make the limited U.S. orbital flights through space.

National Aeronautics and Space Administration Space Task Group will be putting the Mercury pilot through a series of orientation, systems and techniques here at Langley Research Center and elsewhere to familiarize him with the Mercury capsule and its operation. Pilots also will acquaint themselves with those space conditions which can be simulated on earth.

Basic Elements

Simulator work is a basic element in the orientation, training and indoctrination program. The seven Mercury pilots began in April (AWW May 15, '60) to prepare them for the first U.S. launching. It is now time to orbit, probably in 1961. Mercury training is now moving into the final stages of the simulator elements of the program.

Using simplified, ergonomic simulation techniques, Space Task Group has de-

veloped a closed-loop analog simulation of the Mercury capsule, and this is the first system to be used in the training program. Each system of the simulation includes a data system, control system and display panels, a configuration similar to the X-15 control station used in the X-15 control station used in the X-15.

Pilot will be seated at part of the closed-loop system and various displays and controllers will be tested during the training. The system will be a closed-loop mock of the type to be used in the Mercury capsule, and will be equipped with a three-axis controller.

This controller is located in the analog capsule and consists of a continuous flight cycle for the pilot. It can serve three seats, for example, only at discrete points. Although the complete Mercury mission cannot be simulated, the cockpit flight reentry flying mode and reentry phases can be simulated, and the pilot can be seated four or five to another by using quick switching in the computer system.

Since the simulation is a static device, the pilot's seat can be simulated and work is confined to flight control coordination and evaluation of control systems and displays. There is no capability for introducing emergencies

into the system. More advanced simulations, including some dynamic aspects of the Mercury mission, will be developed during the sessions first month and next January in the X-15's configuration. Configuration availability will have the basic Mercury instrument panel with attitude indicator, and an extensive environment simulated. It will have the Mercury road and the power version of the reentry harness, and will have the current pressure and temperature hand indicators.

McDonnell Aircraft Corp., the Mercury capsule's prime contractor, is responsible for the controller design. It will be a three-axis type, in which the pilot controls seat through the pulse of his hand in moving the respective left or right pitch through 90°, yaw through 180°, roll through 90°, and right around a pivot point three inches below his hand.

This three-axis controller is a derivative from the usual aircraft control system, and it has been suggested that the Mercury pilot might become familiar with the controls in the seats that are familiar with their aircraft operation. Space Task Group expects the pilot to attain the three-axis controller at a superior portion of time they get some practice with it in the simulator.

Launch Acceleration Pattern

In this configuration, the launch acceleration pattern will be a nine-second linear rise with no pitch control function during the actual Mercury launch. There will be no dynamic motion in the attitude maneuvering simulation because there are no large accelerations involved. In this phase, the Johnson test site at Johnsville will be generally the same as the August program, except it will be simulated with an sophisticated, probably with some capability for simulation of the launch. The Johnson test site at Johnsville will be simulated on the McDonnell heated training flight, the points to simulate to make.

On bearing orbital altitude simulation will be used at Langley to train the pilot in orbital control during orbital flight. This simulation function consists more as an bearing to the orbital altitude and to get the pilot some altitude practice with the reentry system so that they will not control altitude.

In this simulation, the pilot has on his back in a Mercury couch. A waist angle lever and a nose cone are used to project an earth model project on a simulation of the Mercury capsule screen. The pilot will use this device to picture to various attitude control and to acquire some navigation training.

McDonnell is scheduled to build a series of reentry in the actual capsule configuration, using Space Task Group's configuration, using Space Task Group's configuration. Two capsule trainers will have faithful reproductions of the



C-119 Recovers Discoverer Payload in Test

payloads of General Electric payload for the ARPA Lockheed WGS/115 Discoverer satellite is tested in a cable trailing from a Fairchild C-119 during practice tests of an recovery of the unit after it has been ejected from orbit. In tests, the payload is dropped from another aircraft. In the photo at right, a mock system pulls the capsule into the C-119's bay.

orbital flight training table, according to David Johnson, chief of the flight mechanics section of STG's Operations Division. Some accelerations factors will be used to check out the harness with the Mercury pilot.

The training exercises in the earth simulation here at Langley are largely for engineering evaluation of the system, the controllers and the displays. The work at Johnsville will last this fraction, but it also will provide the pilots more realistic familiarization with the Mercury system. The Johnson exercises will be generally the same as the August program, except it will be simulated with an sophisticated, probably with some capability for simulation of the launch. The Johnson test site at Johnsville will be simulated on the McDonnell heated training flight, the points to simulate to make.

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In this simulation, the pilot has on his back in a Mercury couch. A waist angle lever and a nose cone are used to project an earth model project on a simulation of the Mercury capsule screen. The pilot will use this device to picture to various attitude control and to acquire some navigation training.

McDonnell is scheduled to build a series of reentry in the actual capsule configuration, using Space Task Group's configuration. Two capsule trainers will have faithful reproductions of the

Mercury cockpit. One will be used in the development and checkout of the active control system. There, the pilots will gain steering capability. The other sophisticated crew trainer will have more advanced instruments and probably a periscope display monitor. It will have a more capability for simulating a real test mission.

The environmental training will be a simplified capsule with proton and environmental equipment to familiarize the Mercury pilot with the operation of the test system. This will have a simple flight simulation capability. Initial work with the environmental equipment will be done at sea level pressure and the simulator will later be put in a vacuum chamber.

Post-Launch Training

Escape and recovery training will deal with conditions the pilot will meet after landing. It will cover the use of ejection equipment, getting out of the capsule, at various seat positions and restraining, and using the seat. The training will have all the inherent implications the pilot must contend with in leaving the capsule, and it will have the same center of gravity as the Mercury capsule so that it will behave the same in water.

Training will take place with the capsule and recovery simulator in the water. It will be done whenever the recovery system can be freed, including launching parachute, main, Checkpoint, Blue and the Atlantic Ocean. Training may be coordinated with a number of the Navy recovery crews. An aerial capsule will be gondola mounted in the airframe and trained at

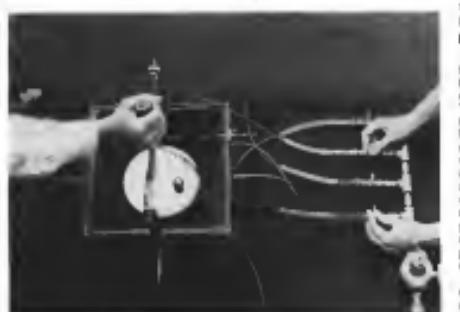
Langley Research Center for flying of the reentry capsule and checkout of the active control system. There, the pilots will become familiar with the sound of the reentry fire and will become accustomed to using the hydrogen peroxide jet control system.

Parachute work with the weighted conditions of orbital flight will be conducted with zero-gravity aircraft flights. Some of the pilots made such flights early in the program in a specifically equipped Convair C-131, and some of those flights in planned Space Task Group tests to determine the possible effects of reentry following a zero-gravity condition. Some flights were made in a weak class Wright Air Development aircraft, but they were not considered suitable.

Zero-gravity flights of longer duration than is provided by the C-131 are being arranged, and STG is studying the use of the Lockheed F-104 for this purpose. Work also will be done with the Bell X-11 as X-11 during the training program but no final decisions have been made. This will not be the North American X-15.

Mercury pilots will use a water tank zero-gravity simulation developed here at Langley, although this will be questionable until the tank system has been tested. With this simulation, a man is part in water and his torso is suspended in the water. This provides a fair simulation of zero gravity.

Ballistic space flight control system trials developed here will provide practice in control training with no damping and no spring response. The pilot grasps a handle with a dial set



BALL DISK space flight control module provides Mercury pilots with practice in using control systems with no damping and no spring response. Pilot grasps handle and moves the ball to keep the freely falling ball centered on it. As he does so he is used to the ball's center of gravity, which will be used to keep the ball centered on the disk as module is free-flying. Reaction control jets will be used only at the initial stage of the Mercury program.

THE NAVY'S POLARIS:

DONNER helps it think...

One day soon the U. S. Navy will file a report more fantastic than any sun serpent tale we've ever heard. That will be the launching of the Navy's spectacular Polaris missile from a submerged nuclear submarine. Advanced testing is underway, but the Polaris will be ready for the fleet in 1960.

Smaller and lighter than other intermediate range ballistic missiles, this formidable Lockheed developed weapon features much that is new in advanced electronics. It even "thinks" for itself.

One such "think" device aboard the Polaris is a system developed by Donner Scientific Company using as a base a standard Model 4310 Accelerometer. The system monitors flight performance like a periscope director's telescope. If, for example, in the initial portion of the flight, the missile does not achieve sufficient velocity by a pre-determined time, the Donner system aborts the flight. The missile gets the go-ahead only as programmed.

Donner's role in the Polaris project represents another heavy contribution from an engineering team which specializes in accurate systems, interlocking time, acceleration, velocity and other inputs designed to meet customers' requirements.

Donner welcomes your inquiries concerning the company's capabilities in this and related fields. Write Dept. 333.

DONNER SCIENTIFIC COMPANY
Concord, California



Satellite Radar Must Be Ultra-Reliable

By Philip J. Klass

Washington—Development of a long-range, ultra-reliable weather radar requested by National Aeronautics and Space Administration for use as a meteorological satellite represents a major challenge to the ingenuity of the nation's radar designers.

With a radio equipped meteorological satellite, NASA scientists hope to obtain a three-dimensional picture of precipitation around the earth, enabling meteorologists to detect major storms far in advance, disperse them and to monitor the earth's heat below.

Design Requirements

Here are a few of the challenging requirements that must be met if the specifications which NASA want to radar are to be met:

- **Reliability.** Radar must be able to operate continuously and reliably for a minimum of six months, potentially for a full year. Some simple adjustments for improving performance must be possible by means of remote radio control.

- **Coverage.** Meteorological satellite will be stabilized so that one can resolve perpendicular to the earth's surface, with no rotation about this axis. NASA would like a scanning radar which can provide full coverage of all of the earth that can be viewed from the satellite but will settle for a strip a little more than 100 km wide. The satellite will be stable for a strip a little more than 100 km wide, the satellite if the former is not feasible.

- **Range.** First models of the radar will operate from a satellite at an altitude of about 500 mi, but the ultimate design must be suitable for orbits at altitudes of 900 to 1,000 mi.

- **Resolution.** NASA seeks a resolution equivalent to about 5 mi on the earth's surface. This corresponds to a horizontal width of about one degree for a satellite at 900 mi altitude. To establish height of precipitation above the earth, NASA seeks a range resolution of about 1,000 ft.

- **Electric power.** First models will be powered by solar cells and storage batteries capable of supplying only 40 to 100 w average power. NASA says ultimately, the power available in the meteorological satellite is expected to be no more than 100 watts. (By way of comparison, existing satellite weather radars with a maximum range of about 140 mi require 700 to 1,000 w power.)

- **Sensitivity.** If possible, radar should be capable of detecting precipitation falling at the rate of 0.1 in per hour corresponding to a radar reflectivity of 0.0000035 in return per cubic meter. Radar receiver should have a logarithmic response as a function of re-

ceived signal strength. Receiver output should be in discrete steps with 5 to 10 steps.

- **Aerodynamic physical parameters of the solar arrays.** To achieve a strong wind would produce torques that would destabilize satellite stabilization. NASA suggests the use of flat-top antennas and electronic scanning techniques.

Requesting Proposals

NASA is asking scientists, for proposals as both a feasibility study of the satellite weather radar and on a second phase that would include fabrication of a working laboratory model. Feasibility study is to be completed by July, 1961, and should include how on early model

can be developed into a more sophisticated satellite system for use in an operational satellite. NASA is stating that the laboratory model should be available by spring of 1963.

Unclassified Techniques

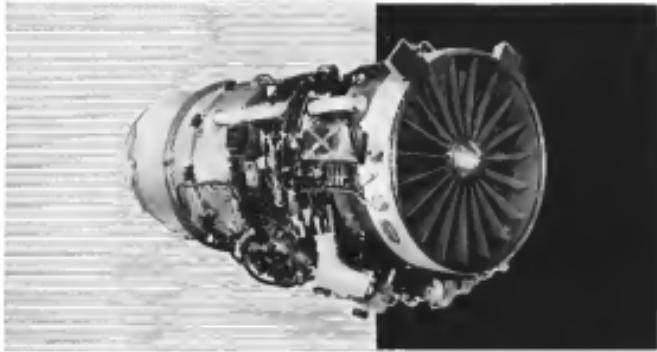
As fast as possible, the techniques employed in the solid fuel rocket to be manufactured, NASA says. If it proves necessary, to use classified techniques, NASA says it will arrange for the use of such information for the contractor and will respect the classification of these parts of the work.

NASA suggests the use of X-band (3.2 cm) for the satellite radar in preference to lower frequencies because of the problem of obtaining decent resolution.



Scientists Study Entry into Venus' Atmosphere

Most nose cone is placed at end of 40-ft shock tube in Lockheed Missiles and Space Division Scientific Research Laboratory in a study of the problem of entry into the atmosphere of Venus. Studies by scientists K. K. Choi (left) and Richard W. Ryerson (right) show problems in 10% greater for Venus than it would be for a return to earth.



DEVELOPED FROM EXPERIENCE

The Rolls-Royce Conway by-pass turbo jet is in production for the Handley Page Victor B.Mk.2, the Boeing 707-420 and the Douglas DC-8, and will power the Vickers VC-10.

The by-pass or ducted fan principle which Rolls-Royce have pursued in the Conway is now accepted as the correct formula for all jet transport and for certain military applications. The new RL.141 family of by-pass jet engines is based on 7 years' development experience of the by-pass principle and on 6 years' operation of other gas turbines in airline service. The first of this series of engines has already been chosen to power the new British European Airways medium range jet airliner.

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larger with retrievable use, whereas this one, if it does not cut out the use of other frequencies.

In the ultimate operational configuration the satellite will be in a circular orbit of radius 600 km with an orbital period of 90 minutes. Power plant and data store the data around the satellite on a tape recorder, then transmit it down when the satellite passes over a ground station.

The contractor selected to study and develop the satellite and its payload will co-operate closely with the managers of the data storage, communications and power system, except as the latter affect the radio design, according to NASA.

Companies that would like to bid on the satellite weather radio program may obtain copies of the specification and information by contacting Director of Procurement and Supply Division, NASA, ESRB, II, RR N-2, Washington 25, Washington D. C.

Soviets Measure Geomagnetic Field

Moscow-Soviet Union has disclosed some of the results of its satellite and rocket program to scientists at the International Cosmic Ray Conference here. A report on the results of Soviet space research that was delivered last March to the USSR Academy of Sciences in its previous Moscow meeting November 1960, has now been published in translation to reveal Soviet research.

The report states that Soviet research has established that ions with a mass number of 16 predominate at heights from 210 to 3,000 km, with atomic oxygen constituting the basic gaseous component from a height of 276 km to at least 500 km. Atomic oxygen also has been detected as well as heavy particles with molecular weights of 78 and 10. Scientists said.

With further investigation this situation can be substantiated by solving the remaining three problems of the upper atmosphere, it said. The report stated that atomic oxygen creates an obstacle to atomic oxygen energy, from 15% to 18% depending on height and atmospheric latitude, and varies with type of ion. "Definite dependence of ion density on geographic latitude has been determined," the report concluded.

Nevertheless, and "extremely important results were obtained in measurement of the geomagnetic field with the help of Soviet space rocket."

"It has been established," it said, "that the difference between theoretical and factual values becomes appreciable at a distance of approximately two terrestrial radii from the center of the earth and that increases sharply."

Variations in the magnetic field



A pretty dark situation, indeed—when a simple electron tube failure can shut down an equipment or entire production line fast! Use IERC's new set of **a**, **b**, **c**'s to help you get improved electronic equipment reliability. **a**. The practice of replacing tube failures is amateur and ultimate! Is that of replacing a light bulb a better protection nor ease against a continuing high rate of electron tube failures? **b**. Down-time, labor replacement costs often add up to 10 times the tube cost! **c**. You can actually increase tube life up to 12 times by specifying and using IERC Heat-dissipating Electron Tube Shields! The full facts, in the form of **d**, complete product literature **e**, test reports, **f**, engineering data and **g**, tube shield application guides, especially prepared to help you "see the light" are available on request—write today!

Patent 3,000,019 2,500,000 or Patent Pending
Over 100,000,000 North American Aviation Inc.

I **E** **R** **C** **S**

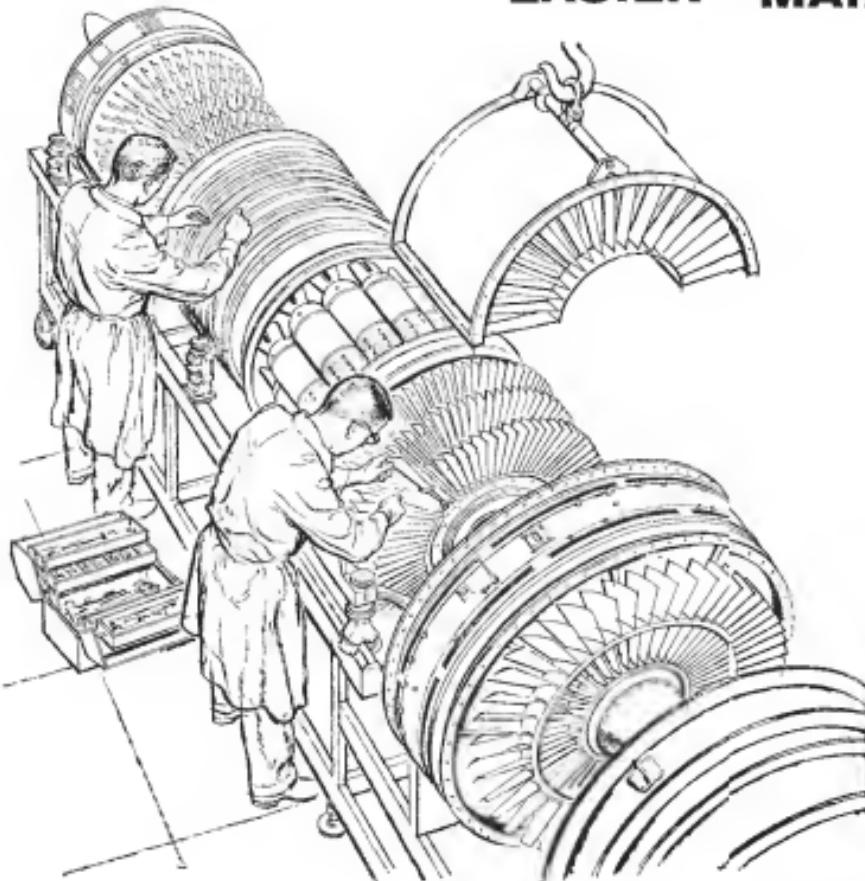
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145 West Magnolia Boulevard
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MAINTENANCE, OVERHAUL



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- Combustion liners, fuel nozzles, igniters, turbine buckets, and compressor stator blades are individually replaceable in the engine.
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- Aft fan stages can be integrated into existing overhaul facilities, with low tool and equipment costs.
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TURBINE BUCKETS can be individually replaced in the field without removal or subsequent re-balancing of the turbine rotor. This is a typical benefit of the design features which simplify maintenance and overhaul of General Electric aft fan engines.



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This overall drawing shows: (Flexonics hose, metal, synthetic, Flexon-T (Teflon), Glycol, air, and fuel joints; Metal bellows and expansion joints; Metal-formed stainless steel parts.)

6-65



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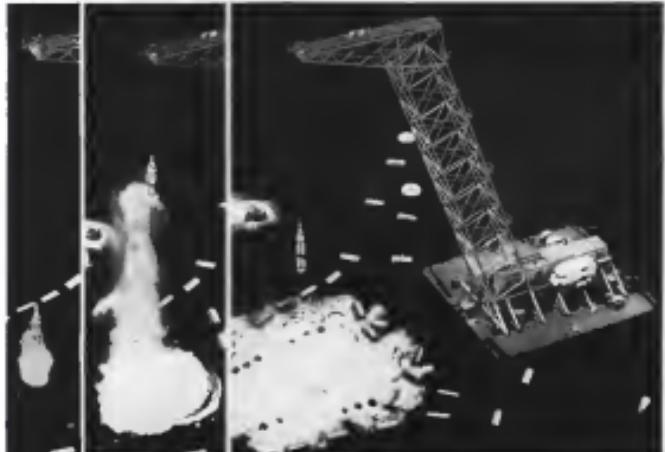
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Crane, Hydraulic Ram Retrieves Polaris Dummy In San Clemente Tests

Lockheed Missiles and Space Division and Westinghouse Electric have developed Operation Polaris to retrieve dummy Polaris missile stages after firing from an underwater launching table. Missiles are tested in the cold-weathered ocean from the 180 ft. long ocean, hydraulic, ram-type, piston lifting it and to keep the Polaris from falling back onto the sea. Polaris is an operation of San Clemente Island an area of U.S. Naval Ordnance Test Station, China Lake, Calif. Polaris recovery method involved use of modified oceanic aircraft serving as a (NW May 25, p. 59)



Honeywell puts man in space -at zero altitude

Advanced space environment simulator will isolate
two men in Honeywell-controlled space flight
environment during unprecedented 30-day test

AS ANOTHER step toward man's conquest of space, Honeywell will provide the USAF School of Aviation Medicine with environmental simulator for use in studying human reaction to isolation in space. The test capsule developed by Honeywell will hold two men and all the life-sustaining materials they need for 720 hours. It provides a completely self-sufficient environment contained in a 12- x 6- x 7-foot package. When man travels space, the air he breathes, the food he eats, temperature control, waste disposal, and all other basic elements must be precisely planned and controlled. This poses intricate problems involving temperature, oxygen, lighting, and many others. In solving these, Honeywell utilizes advanced engineering techniques developed during more than 70 years of leadership in environmental control.

Honeywell Capability

Human environment, however, is only one of many fields in which Honeywell has demonstrated space flight capability. For example *Guidon* and *Stabilus*, Honeywell's reference system

is a terribly accurate means of attitude guidance and control used in orbital applications. *Flight Control*, Honeywell has more experience in the field of flight control than any other company. Proven systems include autopilot, re-action control, jet valve control, thrust vector control and automatic landing systems. *Env. Planning*, Honeywell capability includes sealing, shielding, monitoring and interpreting *Ground Handling*. Some of the most massive and complex work done by Honeywell in the space field concerns the development and operation of test and checkout equipment. This work includes depur, orbital and emergency equipment, base level checkout and maintenance equipment, and branch site checkout equipment. Additional Honeywell experience includes instrumentation, auxiliary aerospace power systems and research into human factors, both biochemical and psychological.

If you have a problem in the design of systems or components in the field of space flight, call or write Honeywell, Military Products Group, 2735 Fourth Ave., South, Minneapolis 6, Minnesota.



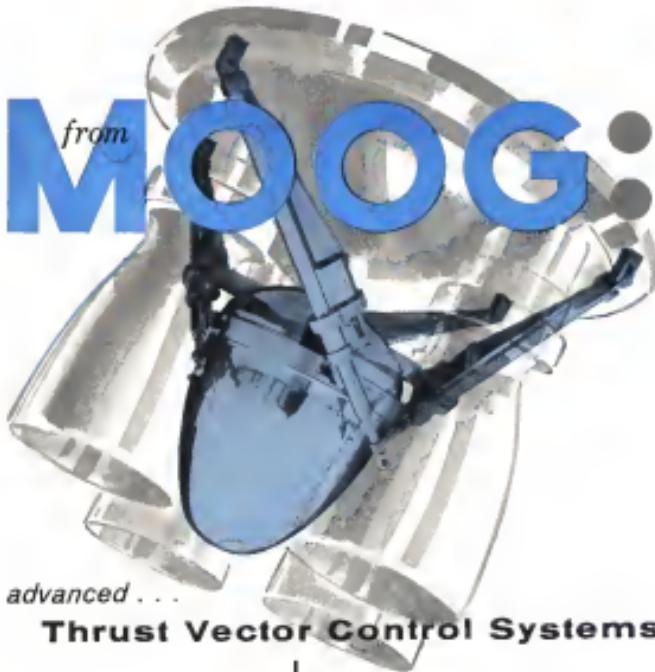
Two-man hermetically-sealed space cabin simulator

The basic observatory of the simulator will contain equipment that would be found in actual space flight. Oxygen, carbon dioxide, toxic gases, temperature and humidity are constantly and individually sensed and compared to a set value. When safety limits are exceeded an error signal is amplified and corrective action is automatically begun. A sufficient water supply and facilities to insure personal cleanliness will be provided. Ample storage facilities for a可口able foodstuff will be provided for the 30-day isolation.

Two-man space cabin simulator will contain equipment similar to that used in actual space flight. Oxygen, carbon dioxide, toxic gases, temperature and humidity are constantly and individually sensed and compared to a set value. When safety limits are exceeded an error signal is amplified and corrective action is automatically begun. A sufficient water supply and facilities to insure personal cleanliness will be provided. Ample storage facilities for a可口able foodstuff will be provided for the 30-day isolation.

Honeywell

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advanced . . .

Thrust Vector Control Systems

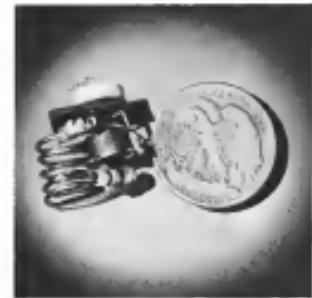
Consult Moog for
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Moog's integrated hydraulic servosystems are lightweight and compact packages which include auxiliary power units and electrohydraulic servomechanisms. The unit above was designed to position a CSM rocket engine nozzle for thrust vector control. A unique mechanical feedback arrangement within the servoactuator eliminates the need for electronic feedback elements. Moog's integral system design provides complete servocontrolled packages for reliable, high performance operation.

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TUNNEL DIODE resonator (left) consists of one variable and two fixed ceramic capacitors, tuning coil, and the tunnel diode located inside the can. Closeup of a tunnel diode (right) shows the counterbore was leading into an offset slot which is soldered to a germanium crystal (dark area) which in turn is soldered to a rectangular metal plate that forms the other anode.



Tunnel Diodes May Cut Transistor Costs

By James A. Foscarini

New York-Sylvania engineer researchers are becoming increasingly interested in the promising new device called the "tunnel diode." Latest results to be announced are those of sensitivity at the General Electric Research Laboratories where tunnel diodes have been manufactured in operating experimental circuits such as an FM transmitter, an FM receiver, and in microwave and crystal controlled oscillators.

Sample Quantities

Characteristics of the tunnel diode that have interested interest include the ability to operate at frequencies as high as 10.5 kilocycles per second, a power requirement as low as one milliwatt of a watt, and an amplification noise figure of about one decibel.

General Electric says that it will be offering tunnel diodes in sample quantities starting September at an agreed-upon price of \$75 per diode. Eventually, the company hopes to make available a complete line of different types of tunnel diodes at prices below the cost of the various types of transistors available commercially today.

Tunnel Diode

The tunnel diode takes its name from the quantum mechanical tunneling phenomenon in which electrons travel more easily through the barrier of the speed of light. This high speed makes possible operation at extremely high

frequencies. Oscillators employing tunnel diodes have been operated successfully at frequencies above 2,000 mc, and General Electric says that it expects to obtain operating frequencies above 10,000 mc in the near future.

Several advantages are claimed for the tunnel diode over the standard transistor. The tunnel diode is smaller than a conventional transistor and, because of its regular structure, obviously should be reduced to a fraction of its present size. It is extremely immune to environmental conditions. Shells and diodes made by General Electric have been operated at temperatures to 650°. Measurements indicate that the diode is 3,000 times better at reducing

the actual effect of random radiation.

One of the most interesting characteristics of the tunnel diode is that it is a negative resistance device. First reported by Dr. Leo Esaki of Japanese Sony Corp. in early 1958, the device has already made inroads in the industry. Other companies claim to be actively investigating tunnel diodes on RCA Laboratories, Bell Telephone Laboratories, and Air Force Cambridge Research Center. Several different materials are being studied, including silicon, germanium, gallium arsenide, gallium antimonide, indium antimonide, and silicon carbide.

In quantum mechanical tunneling, an electron, or a hole, disappears from one

Comparison of Tunnel Diode Characteristics

	Maximum Frequency of Operation (in mc)	Minimum Power Requirements (mw)	New Pulse Amplification at 1,000 mc
Tunnel Diode	2-10	0.00001	100-2000
Transistor	2	0.005	2,000
Vacuum Triode	10	0.1	5000
Parametric Amplifier	6	30	5000
Resonating Waveguide	40	30	2000
Maser	10	400	1000



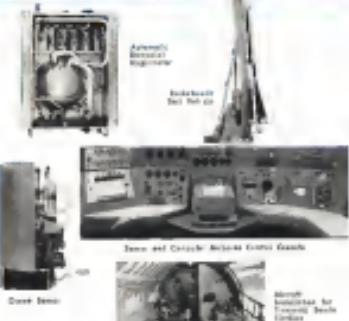
AN/AMQ-15

... concept to reality in one year

Just one year ago, the Air Force Global Weather Reconnaissance Program was only a system concept. Today, the feasibility of this advanced navigation system has been demonstrated at realistic speeds and altitudes.

The Bendix AN/AMQ-15 system includes advanced aircraft sensors for measuring flight attitude, airspeed, pressure, using the flightpath, and advanced drop sonde and reentry sensors for measuring aircraft parameters in a vertical profile from sea level to 150,000 feet. Other subsystems are stereo radar, clear day and base radar, air sampling, nuclear digital data processing, and display, and ground data handling.

For flight demonstrations up to altitudes of 45,000 feet, the Boeing Airplane Company has installed AN/AMQ-15 subsystems in their prototype 747 jet



Bendix Systems Division

4999 Midway, Michigan



transport. In addition, Bendix has conducted flights of test aircraft at Edwards Air Force Base. In reporting this achievement of a major system design and implementation, Bendix is very proud of the contributions of its own division, and in most appropriate manner the contributions provided by the Air Force, Boeing, and other subcontractors. The result is a flexible and modular system which can be used in various fixed packages for all types of aircraft ranging from strategic bombers to interceptors, and for civilian transport aircraft.

The AN/AMQ-15 is typical of the high-risking programs being carried out by Bendix Systems. Better engineers and scientists interested in progressive systems of the future are invited to join this growing team.



TUNNEL 2406, shown in use at bottom, is capable of the functions necessary for an FM inverse amplification, microwave, ion-beam heating, detection, and microwave frequency control. An FM inverse limit using a tunnel diode, the conventional resonators shown at the top could be omitted, with some sacrifice in performance.

site of a potential barrier and without records against the other side, although it does not have enough energy to surmount the barrier. In the case of the tunnel diode, the barrier is the space charge depletion region of a p-n junction. This is the same barrier which prevents current from flowing in the reverse direction as an ordinary zener diode.

This barrier is made extremely thin by the tunnel diode—less than one millimeter of an inch—so that penetration by the tunnel effect is possible.

The greater the current, the additional current in the diode at very low forward bias which disappears when the bias is increased.

It is this additional current that provides the negative resistance in the diode.

Free Carriers

The origin of this additional current can be explained by considering the change in the characteristics of a non-uniform $p-n$ junction diode at higher concentrations of free carriers as added to the junction.

As the density of charge carriers is increased, the reverse breakdown voltage decreases.

This reverse breakdown voltage, however, does not reach a limit at once. The lower bias is determined by the mobility of the carriers which determine the reverse characteristics. Experiments have shown that even uncontrolled carriers can be doped heavily enough so that the diode can still be in the reverse breakdown condition at a small forward bias.

When a larger forward bias is applied, the diode goes out of the reverse breakdown condition and the current falls to a small level. The reverse breakdown current that flows with a forward applied bias establishes the negative resistance of the diode.

Diode Advantages

In competition with conventional valves, tubes and other electronic devices, General Electric believes tunnel diodes have the following advantages:

- For communication applications, tunnel diodes compare with transistors, parametric amplifiers, vacuum triodes, varistors and diodes, traveling wave tubes, and mixers. Tunnel diode characteristics is to compare them for high oscillation frequency, microwave power requirements, and low noise amplification (noise figure of one decibel).

• In computer applications, tunnel diodes will compete with transistors. The diode is at least 100 times faster than present day transistors, according to General Electric, and can be made to compare with about 1000 times the power. Tunnel diodes also are relatively immune to temperature changes which can prevent inverse amplification without increasing mobility.



Electrostatic Gyro

Highly accurate electrostatic gyro which generates rates is incorporated in a system of charged fields similar to conventional bearings in shown here. Electrostatic low-drift gyro, developed in Minneapolis-Honeywell, will employ two sets of bellows and mounted to telescopes of high-precision optical instruments. Honeywell began the research under Navy Bureau of Defense sponsorship and recently received USAF contract to study airborne application. Glass tube-type gyro uses a gas to measure several various. General Electric also is developing electrostatic gyro implants.

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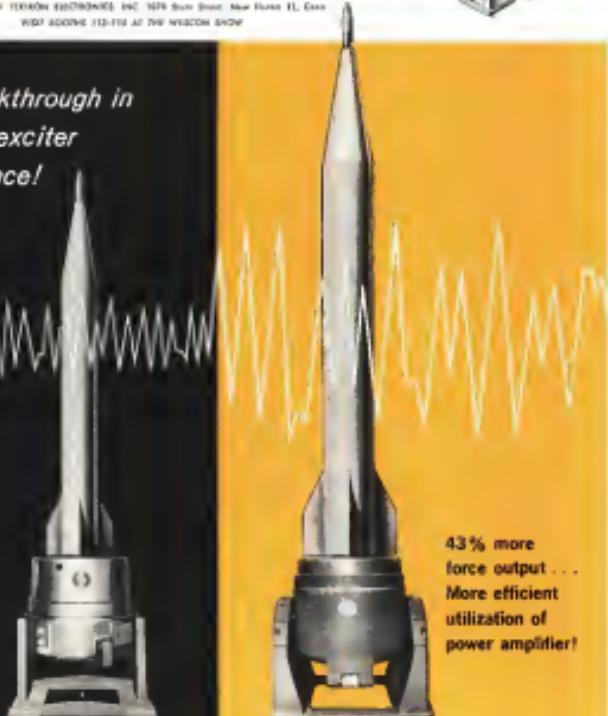
Leading companies in missiles, aircraft and electronics look first to MB for progress in complete vibration test systems. It has been that way for almost 15 years. Our "encyclopedia" of vibration experience is yours to draw on... as is the largest, national, field service staff of specialists. Send for full data.

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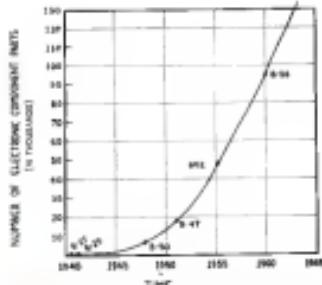
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WEST ADOPTS 710-111 AT THE WISCON SHOW



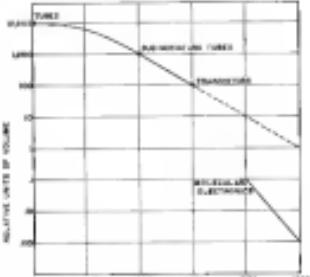
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vibration exciter
performance!



43% more
force output...
More efficient
utilization of
power amplifier!



GROWING COMPLEXITY OF MISSILE EQUIPMENT. Graphed above is a curve of the approximate number of components, with a potential total of representable future. Microelectronics gains addressed in the last two decades through the use of major components, tubes and transistors, are compared at right with the results reported from the Air Force's new molecularics program.



USAF Investigates Basic Moletronics

Dayton—During the past decade, Air Force weapon systems have become increasingly complex in order to accomplish their increasingly difficult mission requirements. One useful example is the number of electronic components required.

During the B-57 aircraft program, the B-57 and B-59 aircraft required about a couple thousand components; the B-57 has since increased to 20,000 and the B-52 approximately 50,000. The total for the Convair B-58 is around 95,000 and the North American B-70 will show a corresponding increase.

Design Problems Created

This trend has created a number of major problems for the aerospace vehicle designer, including size, weight and electric power requirements. Perhaps the most critical is the lower reliability which results from the unavoidable loss of冗余 of the reliability of a system as a result of the number of the reliability of each of its individual components. In addition to the components themselves, these results are also reflected in the size, weight and power loads on the system for every component—each an other potential source of failure.

The electronic industry has not had striking technical progress in the last few years. It has improved the performance of components and has made significant advances in their size. However, the new results that the reduction in size has been approximately a straight-line function for the past several years. This is not adequate to meet the growth in overall complexity of weapon systems and the demands for small size, weight and power of air and space vehicles.

Furthermore, it appears that a continuation of the non-linear growth cannot meet our needs. We need a new concept, or breakthrough, in the electronic components field.

Several years ago this situation was discussed with a number of representatives from industry and contract which were well aware of the need for breakthroughs which could be achieved.

From a contractual standpoint, these programs were extremely beneficial but we learned that one cannot expect for a breakthrough.

At first we were thinking of functional components which were defined as single items that could replace a tube or transistor and its family of supporting passive components. This would mean a major step to simplicity, reliability, and/or performance in a single electronic function normally found in a complex system. We were even so visionary as to think of a complete communication or radio function that would be as simple as to have replace input and power loads only with the inclusion being a solid material instead of an assembly of hundreds of components.

The term "moletronics"

has been coined by the Air Force to describe this technology for which no specific nomenclature has been defined as the synthesis of materials with predetermined electronic properties at such that under a particular stimulus the matter exhibits complex and complete electronic functions that previously were performed by a distinctive combination of active and passive components.

A molecular electronic item that performs such a function has been named a "functional electronic block," or FEB (pronounced "Fee-B"). A FEB might, for example, contain a 2nd power transfer function of 40 dB at 15 Hz with a 30 dB bandwidth and a output of 100 microvolts.

Research Program

Because the previous concepts did not work, a new approach was taken. It was felt that a much better thing would be to create a research program whose output would be an investment in time and money to revolutionary advancements in power load reduction.

To stimulate a scientific reflection in this field through applications of molecular electronics required a long-term program which could only be obtained through avarous and extensive research programs. The source of the molecular electronics approach is highly dependent upon the resolution of basic information about the structure of atoms, molecules and crystals of matter and on the development and application of new and novel concepts and approaches to the design of new systems.

Full advantage had to be taken of